FOUNDRY TRADE JOURNAL

EST. 1902

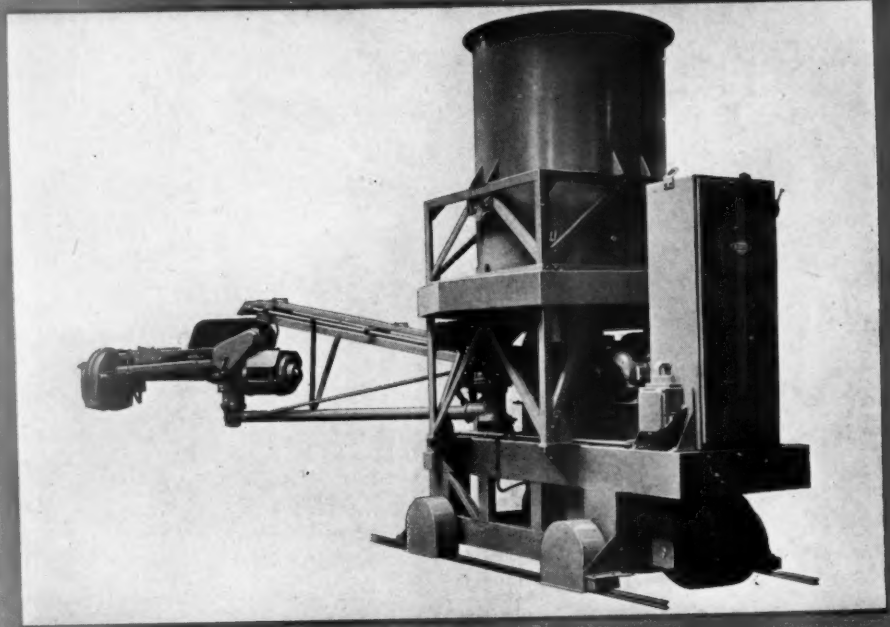
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

VOL. 103
No. 2131
Registered at the G.P.O. as a Newspaper

AUGUST 15, 1957
Offices: John Adam House, John Adam St., London, W.C.2

Single Copy, 9d. By Post 1/-. Annual Subscription [illegible] Abroad 40/- (Prepaid)

SEP 5 1957
EAST ENGINEERING LIBRARY



Mobile Type Sandslinger as supplied to
The Staveley Iron & Chemical Co., Ltd.

Sandslinger

Foundry Plant & Machinery Ltd
EGLINTON ENGINE WORKS
120 TRADESTON STREET
GLASGOW, C.5

NARROW GANGWAYS · LOW HEADROOM
ARE NO PROBLEM

YARD CLEARING · ASH CLEARING
TAKE LESS TIME

Muir-Hill Regd.
BUILT BY BOYDELL

Are these your bulk handling problems—then the Muir-Hill LH-1 10·5 cu. ft. hydraulic loader can help you too. As a first step send for the LH-1 brochure.

LH-1 HYDRAULIC LOADER

E. BOYDELL & CO. LTD., UNIVERSAL WORKS, OLD TRAFFORD, MANCHESTER, 16

dmEB 743

FOUNDRY TRADE JOURNAL

Established 1902

Vol. 103 Thursday, August 15, 1957 No. 2131

Editor:
V. C. FAULKNER, F.R.S.A., HON.M.I.B.F.

Assistant Editor: A. R. PARKES, M.I.B.F.
Commercial Editor: P. E. CARDEN.
Advertising Director: F. BARRINGTON HOOPER, B.A.
Production Manager: R. J. LOVELL.
Publisher: H. J. DWYER.
Circulation Manager: E. T. GRIFFITHS.

District Representatives:
G. P. ELLIOTT (*Northern Area*)
T. H. SMITH (*Scotland*)

PRINCIPAL CONTENTS

Technical : PAGE

IBF Annual Conference:
Abstracts from, and discussions of, papers presented at the conference held at Harrogate, last June. Subjects dealt with include alloy-iron and machine-tool castings, production in a jobbing foundry, melting and treatment practices, test-bars, maintenance, and mould drying . . . **183**

New Light Foundry at K & L:
Details are given of plant installed in a new extension to the works of K & L Steelfounders and Engineers, Limited, for producing the lighter type of steel . **191**

Salt-bath Graphitization Applied to High-sulphur Irons, by Olivier Bader and Daniel Godot:
Translation of a paper presented to the 30th congress of the *Association Technique de Fonderie* **195**

American Stainless Melting Practice . . 203

Features :

Leader: New Foundry Process . . . 181
Correspondence **182**
Equipment and Supplies **189**
Book Reviews **201**

Commercial :

British Blast Furnaces **198**
Company News and New Patents . . **200**
Imports and Exports of Iron and Steel **206**
Raw Material Markets **208**
Current Prices of Iron, Steel and Non-ferrous Metals **210**

AN INDUSTRIAL NEWSPAPERS PUBLICATION

Published Weekly

Single copy 9d.; by post 1s.
Annual subscription: home 40s., abroad 45s. (prepaid)

17/19 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2

'Phone: TRAfalgar 6171 (10 lines)
'Grams: Zacatecas, Rand, London

New Foundry Process

It is only too infrequently that we can announce a new foundry process, although since the war there have been the development of shell moulding and the CO_2 Processes to widen the boundaries of the art of casting metals. Whilst these two processes were generally applicable to the complete range of the conventional alloys, the one described in this issue* is confined to the production of malleable cast iron. The work has been carried out in an Ardennes foundry by Mr. O. Bader and Mr. D. Godot, and the experiments disclosed show more economic benefits than merely improved mechanical properties

Fundamentally, the economy resulting from the new process is based on the reduction of the calorific energy required to heat malleable castings to the temperature at which they will rapidly graphitize. In the conventional processes, heat transfer is *via* a metal box packed with ore or other materials or from a gaseous atmosphere. It is claimed that by using a liquid-salt bath, a process is available which is 71 times quicker than the packing-in-ore process and eight times more rapid than special gas-atmosphere annealing. A number of other claims for economies are made, such as in mechanical handling, absence of deformation and better use of working time.

It should not be imagined that here is a ready-made process, which any malleable ironfounder can install with success *ab initio*. There is much "know-how" to be acquired and many trials will have to be made before commercial results can be established. Moreover, the process, which does seem to lend itself to automatic operation, will have to be engineered with this end in view. So far, the Authors have detailed the type of furnace they have found satisfactory and have also given the mixtures of salts suited to the system, but these appear to be French proprietary brands and their equivalent will have to be determined in any country emulating the practice disclosed or importations will have to be made. Most locations, however, have raw materials for salt baths readily available. It would occasion us neither surprise nor embarrassment to hear that salt-bath experiments in this field have taken place in the past, as fundamentally it is rather an obvious step to take. So far as we know, however, this is the first time that extensive publication, backed by experimental results, has been given to the process. Moreover, in the paper no Patent rights are mentioned or claimed. Finally, we congratulate the authors and their *patron* for the description of what we believe to be a novel and potentially economical means of annealing malleable castings.

* See page 195.

Correspondence

SANDWICH COURSES

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—In a letter which you published in your issue of August 1, Dr. E. A. Rudge describes the situation which is arising at West Ham College of Technology in connection with the sandwich course in chemical engineering. As I understand it, Dr. Rudge's argument is as follows. There is a general need for more chemical engineers. The West Ham College of Technology, in seeking to meet this need, has a capacity to train more chemical engineers, but is limited by the unwillingness of firms to co-operate. Therefore, the firms concerned should without delay revise their recruitment and training schemes, in order that the spare capacity at the College may be utilized.

On the face of it this is a sound argument and reveals a disturbing situation. However, I am prompted to make a number of observations and to relate Dr. Rudge's arguments to conditions in the foundry industry. First, "evidence of a grave shortage of chemical engineers" is by no means the same thing as saying that particular firms have x number of vacancies. There is evidence of a general shortage of trained technologists in the foundry industry, but one should not deduce from this that any large number of foundry firms have at this particular moment to leave vacancies unfilled. They might benefit from the employment of more technologists, but before they can employ them to the best advantage considerable changes in the organization and methods of the firm may be required. It is in fact a vicious circle situation, which will not be broken merely by revision of apprenticeship schemes. Reference is made to this matter by Professor C. F. Carter and Professor B. R. Williams in their recent book on "Industry and Technical Progress."

It will be interesting to know what considerations prompted Dr. Rudge to make the sandwich course in chemical engineering works-based. He states that in some cases a works-based course has been unacceptable to firms. The general arguments in favour of works-based courses, which have been given wide currency by the Minister of Education, are of course sound, but to my mind they relate to the very large firms which have highly-organized training schemes within the works. For the small firm there are very real reasons why the works-based course may be impractical, and financial considerations are by no means first in importance. To mention only one of these, the small firm will usually be able to forecast just what vacancies will occur within a period of several years, and the amount of choice open to a sandwich course student in such a firm will, therefore, be very limited. The experience of the National Foundry College in this connection is instructive. The number of students entering the sandwich diploma course is increasing very considerably, but the proportion of sponsored students is declining. There is, however, no unwillingness on the part of firms to have college-based students for works training, and college-based students completing the course have no difficulty in finding jobs in which their experience and training can be fully utilized. We may think it a pity that more firms do not sponsor students, but by making it possible for college-based students to take its course, the National Foundry College is in fact serving the best interests of the foundry industry.

Yours etc,

JOHN COLLETT,
Training Officer.

Council of Ironfoundry Associations,
14, Pall Mall, London, S.W.1.
August 6, 1957.

Farnborough Air Show

This year's Farnborough Air Show promises to be the biggest and best to date, with more than 350 stands in the main exhibition hall, which has had to be extended to cover some 125,400 sq. ft.—an increase of 12.6 per cent.

A special enclosure will contain exhibits of guided missiles, including the Fireflash, Firestreak, Sea Vixen, Seaslug, Bloodhound, Thunderbird, and the Red Dean. Two test vehicles, the Bobbin and Borzoi, manufactured by Bristol Aircraft, Limited, are also to be shown. Another innovation, this year, is the provision of a grand-stand designed to seat 2,000, this should ease the congestion whilst the flying display is in progress.

The display opens on Tuesday, September 3 (the preceeding Monday being reserved for the Press and technicians) and closes on Sunday, September 8. Tuesday, Wednesday and Thursday will be reserved for guests of the Society of British Aircraft Constructors, Limited, the organizing body, together with a number of important visitors. On Friday, Saturday, and Sunday, the show will be open to the general public; admission will be from 10 a.m., and the flying display will commence, weather permitting, each day at 3.0 p.m. Tickets are obtainable, in advance, from Auto Parks, Limited, 1, Maclise Road, London, W.14., or through the usual agencies, and are obtainable at the gates, for Saturday and Sunday.

Prices of admission are as follow: Friday, September 6 (admission by advance booking only)—adults, £1.; children (under 14) 10s.; private cars (parking fee) £1; motor coaches, £1, and motor cycles 5s. For the Saturday, and Sunday exhibition, the prices are: Adults, 5s.; children (under 14) 2s. 6d.; private cars (including admission for up to 6 persons) £1 10s.; motor coaches, 10s., and motor cycles 2s. 6d.

The airfield is easily reached by road, and the RAC is to provide extensive signposting within a radius of five miles, and also from key points beyond. Extremely heavy traffic is, as in past years, expected, and motorists are advised to start early and to follow the official routes (the writer's experience is that the Hog's Back route, A 31, is least congested). Comprehensive public transport facilities are also to be arranged.

It is interesting to note that some 47 firms with foundries, or foundry companies are included in the list of exhibitors, together with 28 firms, whose products are of interest to foundrymen. Further details of the exhibits of special significance for founders will be given in a later edition of the JOURNAL.

Technical Convention

Last month, Shaw Processes, Limited, organized a two-day convention for their licensees at the Institute of Directors, Belgrave Square, London, S.W.1. It was attended by representatives from 18 British licensees and 12 overseas concerns, which included firms from Japan and America. Points emerging from the convention were that there could be useful collaboration in the exchange of views as to marketing, technology, advertising, and so forth. It was obviously a worth-while convention.

A NEW heavy duty diesel-hydraulic locomotive has been supplied to the Mufulira Copper Mines, Northern Rhodesia, by the Hunslet Engine Company, Limited, Leeds. The locomotive, which has been built at a cost of £35,000, is of 637 h.p. with an 0-8-0 wheel arrangement.

IBF Annual Conference

Brief Report of Some of the Technical Sessions at Harrogate, June 18 to 21

A number of papers presented at the annual conference in Harrogate of the Institute of British Foundrymen are abstracted in what follows, using on several occasions the principal points emphasized by the Authors themselves. The discussion notes have been freely edited to quote as much factual information as possible from the various sessions, and on occasion, reference back to facts recorded in the original paper has been made to preserve clarity. It should be emphasized, however, that in contradistinction to conference reports printed in this JOURNAL *in previous years, no attempt has been made to record a verbatim account of the whole proceedings.*

"Production Problems in the Manufacture of Alloy-iron Castings," by W. M. Lord, B.SC., A.I.M.

The first paper of the technical sessions held during the IBF annual conference at Harrogate was given by Mr. W. M. Lord, his subject being "Production Problems in the Manufacture of Alloy-iron Castings." In the 10 minutes allotted to him at the commencement, the Author gave a resumé of the salient points and showed an excellent series of coloured slides. In the paper, Mr. Lord described the conversion of cupolas for water cooling, the use of standard moulding-box sections with interchangeable bars and an electrically operated box-turnover machine. His method of making spheroidal-graphite castings was dealt with and typical castings listed. The paper also detailed the technical control required to manufacture a wide variety of castings and concluded with notes on production planning.

Commencing the discussion of the paper, a member referring to the use of cast-iron moulding boxes, asked "why not s.-g. iron boxes?" The Author replied by saying that s.-g. iron would certainly seem to offer good possibilities. He considered steel was not rigid or accurate enough for sizable boxes and hence, was inclined to the use of cast-iron. Another speaker said that he had had two years' experience with s.-g. iron moulding boxes and had found them excellent; instead of using a turnover device, boxes with end trunnions could be turned over with an endless chain or by crane. Bearing in mind "furring" with hard water, the Author was asked whether he had any trouble when using canal water for cooling the cupola. Mr. Lord replied that he used a positive pump and that he had had no trouble, as the canal water was reasonably clean. An Australian visitor asked why a sealed ladle was used for treatment of s.-g. iron and he was told for reasons of economy.

Other Operating Details

A speaker asked whether a hard metallic shell built up on the faces of the cupola cooling blocks and had to be removed. The Author said that the use of a thin coating of ganister over the cooler-block faces (about ¼-in. thick) prevented any further trouble. To a question on melting metal for the manufacture of s.-g. iron castings, Mr. Lord said a loss of silicon was experienced and it was necessary to have a reasonably high pouring temperature but cooling the cupola did not seem to affect this much. Practising the "dilution" method of making s.-g. iron sometimes helped with temperature. A speaker said that on quite a small cupola he had experienced a large temperature loss when using water-cooling segments, and now used spray cooling on the outside, with three rows of sprays. Oxygen enrichment of the blast was now practised and gave an increment of about 50 deg. with 4 per cent. oxygen. With such a furnace as was described, a member said that blast velocity through the tuyeres was very important—high blast-pressure and comparative small tuyeres were necessary to get the blast to centre of the furnace. Mr. Lord was asked whether he used grooves in his furnace coolers to hold the ganister, but he replied that there were no serrations, but the ganister stuck better after slight crazing. On the subject of using a facing of CO_2 sand and slinging the backing sand, he was asked whether there was any shifting of the facing. Mr. Lord replied that he had experienced no trouble at all in this respect. On being asked whether he had experienced any difficulty in securing the low-sulphur metal necessary for s.-g. iron, Mr. Lord replied in the negative, but said he was using rather excessive Mg additions at the moment, and was going on to a basic-lined cupola in the near future. A speaker, referring to personal experience, said that by using water cooling and arranging a double shift, he had found it possible to double the output from his foundry. The corrugated cast-steel inserts which he had put in had proved quite satisfactory; the outlet water ran at 70 deg. C.

"Production of Machine-tool Castings," by G. W. Nicholls

In his paper, "Production of Machine-tool Castings," Mr. G. W. Nicholls stressed the use of systematic control in the production of this type of casting which involved items up to 60-tons weight. He pointed out that it was essential to plan all procedures well beforehand and stated that three points should be taken into consideration:—(1) weight of the casting and the metal necessary to cast it; (2) major dimensions and (3) the service required of the metal. He then detailed the development of "Plan Sheets" and gave examples of these methods applied to three types of machine-tools. Slides were shown to illustrate the principal points and the value of educating all new foundry

IBF Annual Conference

personnel in the economics of castings production and how best to serve the industry was stressed.

Opening the discussion, a question was asked on the methods of mould drying for the type of production described. The Author said that much research had been carried out to establish how best to operate the rather old-fashioned but still efficient pan-type driers and a standard practice had been developed into a skilled job. A member said that it appeared that the CO_2 Process was not much used in this foundry, was this because of the cost or quality? Mr. Nicholls said that the adoption of any new process was slow and this particularly the case with machine-tool patterns and processes. The CO_2 Process was often used, however, for quickness of replacement of a damaged core.

Moulding Pits

Speaking of the production of large moulds, a member asked whether these were weighted or bolted down in the pits: the height and type of runner box employed, and the method of drying. The Author said that when using old pits the moulds had to be weighted but new pits were fitted with bottom bearers for bolting down moulds. He stressed advantages accruing from the use of dry-sand moulds and deep runner-bushes and said that the hot-air for this was limited to 230 deg. C., *i.e.* to ensure slow and steady drying. A member asked whether there was any metal penetration with these large jobs; and he was told that there was some and no complete answer to this problem had yet been found. Its occurrence depended on ramming density, the type of sand and its refractoriness, bond and dressing. On the question of cores, one member suggested that two or three coatings of blacking should be given and this was endorsed by a further speaker, who said a good idea was for cores to be soaked with thin silica paint and then blacked after the first drying—*i.e.*, it was necessary for the coating to penetrate quite deeply. Referring again to the adoption of the CO_2 Process, the Author said that he had used it with new coreboxes in the production of quite large castings as described in the paper, when he was exploring new methods of production. He agreed that ordinary coreboxes could be used when producing castings by the Process, but said he preferred to confine experimental work to new coreboxes. A speaker asked the Author his opinion of cast-iron *versus* silicon-carbide for denseners, and Mr. Nicholls answered that there was very little difference between the two; he used iron chills once only—as a safety-first measure; he only wanted densened metal not chilled, it should be remembered. There was slight danger in using silicon-carbide denseners in that they sometimes fractured, but if looked after properly there could be a great saving as these could be utilized repeatedly.

"Aids to Production in a Jobbing Foundry" by I. Rees and D. H. Snelson, M.SC.

The paper on the above subject was a joint one by Mr. I. Rees and Mr. D. H. Snelson, M.SC. In it, the core-assembly method of moulding; the CO_2 Process and the application of the mouldable type of exothermic feeding compound were discussed from the point of view of flexibility and increase of productivity in a jobbing foundry. The Authors stressed the importance of pattern design and explained that the shortage of melting capacity had led to the application of exothermic materials. The conditions necessary for obtaining directional solidification and, therefore, maximum yield were demonstrated and a system of designing feeder heads on this basis was described—limitations of this method of feeding were also discussed. The Authors stressed that the real value of the CO_2 Process and core-assembly methods depended on the maximum utilization of equipment, plus ancillary and complementary methods in which economies could also be secured.

Limitations

Opening the discussion, a member asked whether there were any limitations to the CO_2/core-assembly processes, to which the reply was that generally the core-assembly method found most application for small and medium castings where fair numbers were required which could be produced in relatively shallow slab cores. With small cores and very thick metal sections, however, trouble was encountered with metal penetration. Mr. Snelson said he was now trying to use sodium silicate as a green-sand binder. He had found that, by using a viscous silicate and warm sand, on the bench the mixture gave good green-strength—there was one snag, however, and that was short bench "life." A further speaker said that zircon sand could be used with the CO_2 Process to reduce metal penetration. A question was asked on the economics of the block-pattern method of production of moulds, the speaker saying that he thought that this method would be expensive from the point of view of cost of materials; how could the economics of the method be assessed? Mr. Rees replied that the cost of the materials was definitely not the criterion here, for instance he used one small segmental core-box only for producing a mould for 82-in. dia. rings. This corebox cost a very small proportion of the cost of a complete pattern. For another example, Mr. Rees quoted one job he had done in CO_2 sand where in the particular job the number of crane lifts had been reduced to a fraction of the number required when the same job was done by ordinary methods, thus freeing the crane for other work. He added that this was the sort of saving difficult to reduce to £ s. d., but nevertheless a very real one.

"Melting Losses in Crucible Melting Practice" by R. S. Jackson, B.SC., *and D. W. Brown,* F.I.M.

In this paper, the authors showed how losses incurred in crucible melting varied with melting procedure and indicated the way in which they could be minimized. A range of compositions typifying the most-commonly-produced copper alloys were used (including 85/5/5/5 and 86/7/5/2 leaded gunmetals, a phosphor-bronze, a common

and high-tensile brass), in experimental work carried out by the authors in the foundry of the Morgan Crucible Company, Limited. Two furnaces were employed in the test—a 400-lb. central-axis tilter and a 120-lb. lift-out furnace—and new crucibles of the plumbago "super-rapid" type were used. Both the furnaces used for the test were oil fired. Effects of various melting practices on the losses experienced were examined; these practices included melting under charcoal or a flux, and the effects of oxidizing and reducing furnace atmospheres.

With good melting practice, but without any special precautions (such as covers), the gross losses in melting leaded gunmetals ranged between 2 and 4 per cent. of the melt weight and in melting common and high-tensile brasses about 2½ per cent.; losses in melting phosphor-bronze were stated as being very small—about ½ per cent. The influence of flux covers was variable with the leaded gunmetals but substantially reduced losses during melting high-tensile brass. The authors stated that conditions which made the atmosphere over the melt more reducing (*e.g.* direct contact of the products of combustion) generally reduced the melting loss; charcoal covers were especially effective, reducing the loss in melting leaded gunmetals to about ½ per cent.

"Lift-out" Procedures

Losses with lift-out crucible furnaces were stated to be generally smaller than in tilting furnaces on account of the more-reducing atmosphere. An estimate made of the direct cost of melting in these furnaces indicated that melting losses usually constituted the major cost of melting. A small reduction in this cost was also possible by arranging "flame contact" with the charge, with the added advantage of obtaining increased melting rates from existing equipment. Flame contact, however, it was pointed out, could not be universally applied, and it was unsuitable where small scrap or swarf was melted and, in addition, there might be metallurgical reasons militating against its use with certain alloys. The saving to be achieved by using flux "D" on high-tensile brass melts was uncertain, the authors said, without data on crucible "life" under such conditions, but they concluded by saying that it hardly seemed likely that a possible decrease in the pot life would outweigh the very substantial saving in metal losses.

"Observations on the Melting and Casting of Aluminium-bronze Alloys, with Special Reference to Test-bars," by C. V. Wilson, B.MET., *and E. V. Tull,* PH.D., B.SC., M.SC.

In the introduction to this paper, the authors made a brief general reference to the alloy itself. The paper was intended to show that if proper attention was paid to the highly individual requirements of aluminium-bronze founding, then such attention would be amply repaid by the full attainment of the attractive properties inherent in the metal. The chief difficulties encountered in the casting of aluminium-bronzes were stated as being: (1) high melting-point (about 1,050 deg. C.) as compared with the more usual copper-base alloys; (2) difficulty in obtaining melts of consistent composition; (3) tendency for gas absorption by the melt; (4) high casting-temperature (about 1,150 deg. C.); (5) tendency for the entrapment of alumina on pouring and (6) susceptibility of the castings to "piping." Considering these difficulties, the authors said that the high melting-point of copper/aluminium alloys gave increased melting costs as compared with the majority of the other copper-base alloys. This increased cost was most evident when plant normally used for melting brass and gunmetal manufacture was employed, since this plant was often under-powered for aluminium-bronze melting, and resulted in very slow working. Prolonged melting in such circumstances led to heavy oxidation of the melt and consequent high metal-loss.

Melt Preparation

Two methods of melt preparation were used, namely (1) compounding directly from virgin metals and (2) re-melting previously prepared alloys. The second method was to be preferred, as a much better control of melt-composition could be achieved. Rapid melting was an essential requirement for aluminium-bronze and provided this was achieved, almost any type of furnace (apart from electric induction furnaces—because of "stirring") could be used. In furnaces employing direct heating, melting could be satisfactorily carried out under a charcoal cover. However, with flame impingement furnaces, gas absorption occurred under reducing conditions, and thus with such furnaces the only satisfactory solution was to melt rapidly under oxidizing conditions and allow for the consistent melting loss obtained. Two main methods could be employed for the prevention of oxide inclusions and these were:— (1) The Durville method, which utilized a quiescent reservoir of the molten metal from which the metal was run in a non-turbulent manner into the mould cavity, and (2) to employ a form of dross trap in the mould from which the mould cavity was filled by a non-turbulent ingate. The susceptibility of the metal to piping could be overcome by the use of chills or by adopting correct casting design. Finally, in the paper, the specification requirements for the two main aluminium-bronze casting alloys were quoted, together with the aluminium contents within these specifications which were to be associated with the optimum mechanical properties.

"Foundry Maintenance," by P. W. Pegg and L. R. Evans

In their paper on "Foundry Maintenance," by Mr. P. W. Pegg and L. R. Evans, particular stress was laid on the necessity of having a good inspection schedule followed by swift action to remedy any faults exposed; this prevented the maintenance department from being merely a "breakdown squad." The authors gave a warning on the need for the training of shop-floor personnel in new techniques. This was followed by a suggestion for a more flexible scheme of bonus payment for

IBF Annual Conference

maintenance workers, and in this connection, after describing the maintenance system in operation at the Authors' company, proposals were put forward based on the following factors: (*a*) maintenance overtime hours; (*b*) plant availability; (*c*) cost of stores; (*d*) absenteeism; (*e*) inspection reports, and (*f*) jobbing work.

A member, opening the discussion on the paper, asked how inspection was applied. It was explained that the firm employed two plant inspectors who, after making an inspection of any plant, wrote out a detailed report on its condition. This report, in duplicate, was sent to the maintenance engineer, a copy being retained in the inspection section. The maintenance engineer was responsible, through his foremen, in seeing that the necessary repairs were carried out and informed the inspector as each item was completed. A speaker suggested that it was important to also have a lubricating schedule and this was agreed. It was also suggested by a member that the maintenance men should be brought into the consideration of any new plant or extensions. A speaker said that spare stock should always be considered in relation to capital "dead" or tied up. Regarding the authors' mention in their paper on the subject of training shop-floor personnel, a questioner asked whether this training was done at a special school within the works or was it incorporated in daily jobs. [The authors state that in their opinion, this training is best effected by individual concerns running courses during working hours—a follow-through idea would be to select the men thought capable of more advanced study and send them one day each week to a college for studying applications of a more general nature]. A member stressed the importance of proper maintenance of compressed-air equipment. This, he stated, was usually most inefficient—he reckoned that it cost £50 per week to supply air which escaped through leakages aggregating to $\frac{1}{8}$ in. dia. He also stressed how inefficient in their air consumption were worn small tools such as pneumatic hammers. Why couldn't a system of tallyboards be incorporated for each item of plant—for jottings each day of jobs needing to be done—he said. The authors said this idea was not easy because it would seem to rely on unskilled men reporting.

Cupola Developments—Report of Sub-committee TS 43 of the IBF Technical Council

This, the second report of the TS 43 sub-committee, was presented by G. J. Shaw, PH.D., B.SC., its chairman. In it, reference was made to the different types of hot-blast plants known to be at present operating in the UK, and a summary was given of the operating details for nine of these plants. High-temperature blast seemed to offer the best prospects but any above-ambient temperature for the blast represented an improvement, the sub-committee stated. Regarding oxygen enrichment, it was stated that this was very similar to hot blast in its effects but was costly. The sub-committee had included no information on water-cooled cupolas—there was too much variation in results reported. Future work of the sub-committee, in addition to keeping the tables up to date, was projected on the design of tuyeres, etc.

Opening the discussion, a member questioned the economics of the hot-blast equipment set out in Table X of the paper, asking whether savings after depreciation included any consideration of maintenance. He was told that maintenance was not heavy and affected the figures very slightly. A further speaker suggested that cheaper plant for hot blast of lower temperatures would seem desirable—it appeared much of the cost of the hot-blast installation was incurred on refractory-lined pipes, offtakes, cleaning chambers, etc., so that separately-heated low-temperature units should be better for shorter cupola blowing periods. Another member suggested that the TS 43 sub-committee should give their attention to what came "out at the top" from the Clean Air Act point of view. A further speaker said that if everyone put in hot-blast installation, there would not be enough scrap available for all their needs.

*"The Hot-blast Cupola as an Economic Unit for Producing Castings to BS.*1452, *Grade* 12"

In this paper by Mr. J. Henderson, the reasons for installing a hot-blast cupola were set out and a brief outline given of the results expected. The outstanding features of the plant were described and charge composition and metallurgical control (including typical charge-sheets, daily analysis results, physical properties for the metal, slag analyses, etc.) were discussed. A section of the paper covered maintenance of the plant and a comparison with cold-blast was made on a cost basis. The author stressed the economic objectives aimed for and said all expected improvements had been secured. One member, in the discussion, elaborated on metallurgical-control considerations and the effect of variables in practice, such as blast-volume alteration. Regarding the cost of the cupola installation, the Author said the net saving on material costs per ton of good castings was £4.975, while the yield of good castings had increased by 7.1 per cent.; in his opinion, the installation would pay for itself in two years. One speaker said he considered that the unit had its maximum value when operating in relation to 24-hour day working of an automatic foundry. A question was asked about tuyere velocity and the author answered that it had been shown that the velocity of blast through the tuyeres had a direct bearing on the temperature of metal produced in a fully water-cooled cupola. With a low tuyere-velocity it had been found impossible to produce iron at a satisfactory temperature even with coke ratios in the order of 20 per cent. On the subject of refractory in the well, the Author said the ramming mixture used was formed of ganister plus 20 per cent. plumbago rammed at a consistency of 12 per cent. moisture and the degree of ramming was very critical.

"Injection Processes in American Foundries," by G. P. Dahm, and C. E. Bieniosek

In this paper, it was stated that the increased flexibility and economy permitted in metal treat-

ment by the use of injection processes had brought about a rapid growth of these techniques in the US during the past three years. The processes depended on entraining finely-divided solid materials in a stream of nitrogen which then delivered them *via* a hollow graphite tube below the surface of a metal bath. Injection processes had been introduced mainly for desulphurization and were now being extended to add ferro-alloys, etc., to the metal.

Equipment Details

The dispenser or "fluidizer" was the "heart" of the system described; these were available in various capacities depending on the conditions and the amount of metal to be treated. Most dispensers had a variable delivery rate; for example, the delivery rate of the 100-lb. capacity dispenser could be adjusted from 6 to 35 lb. of calcium carbide per min. by adjusting the gas pressure in the chamber. The injection tube was usually made of graphite, most foundries used a tube 2-in. outside diameter by ½-in. inside diameter. With such a tube, it was possible to attain calcium-carbide flow rates as high at 35-lb. per min. The slag produced by the injection of calcium-carbide into molten iron was dry and granular, being solid, there was no reaction between this slag and the refractory lining of the treatment vessel. The use of injection desulphurization was, the Authors stated, especially suited to the production of s.-g. iron—in foundries operating acid-lined cupolas, pre-treatment had permitted significant reductions in the quantity of magnesium alloy required to produce s.-g. iron. For example, where a 3 per cent. addition of magnesium alloy was required in normal acid-cupola iron, 1.5 per cent. addition was frequently sufficient for iron that had been desulphurized by the injection of calcium-carbide. In commercial installations where the carbon content of the iron was being raised from about 3.15 per cent. to about 3.40 per cent., the carbon recovery was about 90 per cent. In installations where the carbon was being increased from 3.30 to 3.65 per cent., the recovery was about 60 per cent. Phosphorus was mainly low in cast irons used in the USA, but here in this country the higher percentages which were usual would affect the results somewhat.

Opening the discussion a member asked what was the expected "life" of the injection tube, and was told that this depended on several variables, amongst them metal temperature, metal composition, the quantity of metal in each ladle when making batch treatments or the velocity of the iron when treating metal in the cupola runner. The author reckoned, however, that a single tube would last for about nine injections in the ladle. Further details of the dispenser were given to one enquirer who was told that a hopper under pressure was required with also a stream of gas passing the exit from the hopper to pick up and "fluidize" the powder—a pressure up to 100 lb. per sq. in. was necessary. Answering a question on cost, it was stated that the carrier gas would convey 4 lb. of powder per cub. ft., and of the carbide about 2 to 4 lb. was required to remove 0.01 per cent. S. per 2,000 lb. The authors stated that there was another process in the USA of somewhat similar type, but using lime instead of calcium carbide. Lime was a cheaper material but more was needed for a similar result and then the temperature drop in the metal became serious. Using calcium carbide, the temperature drop was very small, only 17 to 22 deg. C. in a reasonably sized ladle, say, of 12-14 cwt. capacity.

UK Ahead of US

A further speaker said that as producers of s.-g. iron in this country, we were well ahead of the USA in methods of treatment, and to this Mr. Dahm agreed, admitting that the UK "55 Alloy" was not yet available in the States. He also agreed that double-treatment involving first desulphurization and then conversion to s.-g. iron was not ideal because of temperature loss, but he still thought that for the small foundry the use of an acid-lined cupola was still the only practicable melting means for this material and this, of course, did involve double treatment. The author also agreed that in the case of a mains-frequency induction furnace the "stirring" action in the metal might render the direct addition of calcium-carbide quite efficient (as was described by one contributor) and amounts of 8 lb. carbide to remove 1 lb. sulphur were reasonable.

"Mould Drying"—First Report of Sub-committee TS 39 of the Technical Council

This report was introduced by Mr. W. J. Colton who had been a member of the sub-committee for six years. He said that the method of checking industrially the rate of mould drying had now been developed by the sub-committee and it was left to individual founders to apply it. It had been found that (*a*) moisture could move both towards and away from a heated mould surface and the portion "driven back" formed bands of high moisture-content; (*b*) within the temperature range examined (85 to 400 deg. C.) temperature, except in pressurized systems, was the greatest single factor in drying, and (*c*) the depth dried depended upon the moisture/temperature/time relationship. These, he pointed out, were the three principal factors in mould drying. During the introduction of the Report, slides were shown of heat flow. Mr. Colton said that while he considered that the question of temperature was the most important factor, pore space of sand influenced drying rate more than permeability. The aim of the sub-committee was to develop a system or systems of measuring the degree of drying, using metal probes or electrodes inserted or rammed up in the sand mass at definite distances from the heated face, and by applying a voltage across two electrodes from a megger or ohmeter, a marked resistance change could be obtained as the "dry" line reached a particular electrode. Further new types of measuring instruments were being devised by the sub-committee, some of which were for embedding when mould making and others—of the rigid type—incorporated a terminal block and could be set at different depths. The degree of reproducibility of results from the instruments was good.

IBF Annual Conference

The industrial approach to mould drying depended upon developing suitable equipment and four methods of measurement, based on electrical resistance of wet and dry sand were described, together with the degree of correlation and practical application for depths dried, up to 6 in. It was stated that the PVC-covered wire and earth-pin type of probe was developed initially for floor drying of large moulds; the rigid type of probe being introduced because in some cases, difficulties were experienced with the movement of the flexible wires during ramming, and the three-pin rigid probe and cotton-covered probe had also been developed.

Practical Use Required

Discussing practical applications of the Report, a member asked if pressure drying would not be more efficient—had no work been done by the sub-committee on comparative efficiencies of different ways of drying. Another speaker asked whether or not the committee work could be extended in this way, particularly in relation to the Clean Air Act. Mr. Colton answered that these suggestions went beyond their terms of reference but would be referred to the Technical Council of the Institute. However, a founder could now assess the efficiency of these instruments under his own foundry conditions and the tools, he said, had proved their worth already. When a member asked whether a core-barrel could be used as an "earth," Mr. Colton said this depended on the depth and degree of drying required but it would not serve if complete drying were required, because the "earth" must always be wet. A speaker asked whether there was any relationship between the results obtained from the apparatus and, for instance, the incidence of scabbing or cracking of castings. Mr. Colton said that in the limited experience to date, the indication was that there was such a relationship.

"Utilization of Fuel Oil in Foundries"
by L. Marsden

In this Paper, the author said there were only four main grades of fuel oil encountered on the inland market in this country to-day—these were gas oil, light fuel-oil, heavy fuel-oil, and heavy fuel-oil "B"; the lightest oils were the most expensive. The variation in calorific value of any of these grades was remarkably small and normally less than 1 per cent. Regarding viscosity (Redwood No. 1 = 100), the figures for the four grades mentioned were as follow: gas oil—34; light fuel-oil—220 max.; heavy fuel-oil—950 max., and heavy fuel-oil "B"—3,500 max. Factors involved in the oil firing of furnaces were stated as: (*a*) Storage and handling of the fuel oil in bulk; (*b*) preparation of the oil before atomizing; (*c*) supply of air for combustion; (*d*) mixing of oil and air; (*e*) transferring the heat of combustion, and (*f*) carrying away the accumulated gases. Referring to the heavy oils, it was necessary to heat these grades in storage to minimum temperatures of 65 to 75 deg. F. The author mentioned five types of oil-burner and said that the low-, medium- and high-pressure air atomizers were mainly used in foundries. The five main types of oil burners were quoted as:—(1) pressure jet; (2) spinning cup; (3) low-pressure air; medium-pressure air, and high-pressure air types.

These types of burners were discussed in detail and their limitations, advantages and disadvantages pointed out. The advantages of pre-heated combustion air as a fuel-economy measure and as an essential for high-temperature work were shown. The final section of the paper dealt with some of the more popular applications of fuel oil in foundries and where possible, some attempt was made to quote approximate fuel consumptions, so that comparative costs could be calculated.

The short discussion resulting on this subject was confined to details of oil-firing operation. One user said he had seen complaints of extra scaling when oil firing was used for annealing furnaces—Mr. Marsden said this depended on proper atmosphere control within the furnace; usually conversions of plant to oil-firing from some other type were not too satisfactory from this viewpoint. Some fears were also expressed as to the possible harmful effect of sulphur compounds liberated when oil-firing—on this point Mr. Marsden said maxima could be specified for the sulphur content of oil supplies if this element was important.

Steelworks to be "A Garden City"

Fears that there would be so much smoke and noise from a large steel plant planned to be built at Greatham Airport by the South Durham Steel & Iron Company, Limited, that long-term plans to build 2,000 houses in the area would have to be scrapped, were dispelled by Councillor J. McCann at a meeting on July 25.

Mr. McCann, who is a steelworker, was commenting on a proposal that part of the £150,000 the West Hartlepool Council is receiving for the site should be used to wall in the open lawns of Owton Manor houses to give tenants greater privacy. He said the new works would be like "a garden city"; he had visited modern steel plants and, he said: "You would not know you were at a steelworks at all."

Continuous-casting Machines

An agreement has been concluded between Concast Company, Limited, Zurich, and Dollery & Palmer, Limited, 54, Victoria Street, London, S.W.1, under which Dollery & Palmer will represent that firm in the United Kingdom. Concast, in combination with Continuous Metalcast Company, Inc., of New York, sell and license the operation of continuous casting machines throughout the world according to the Rossi-Concast process. Machines are now in commercial operation casting steel and non-ferrous metals in England, USA, Canada, France, Sweden, and Japan. At the present time additional machines are under construction in several other countries.

SWISS NUCLEAR-ENERGY projects are planned to produce 6,000,000,000 kwh in 1957.

Equipment and Supplies

Plastic/Plumbago Refractories

The crucible department of the Morgan Crucible Company, Limited, is marketing a new range of refractory products under the brand name "Black Sal." Individually they are called Black Sal 900 Cement, Black Sal 1,000 plumbago plastic-ramming material, and Black Sal 2,000 stopper-plugging compound. Basically, plumbago/silicon carbide plastic refractories require only the addition of water to be ready for use.

Black Sal 900 is a plumbago/silicon carbide-based cement primarily intended for jointing plumbago ware; it can also be used as a refractory wash. Black Sal 1,000 is a plumbago/silicon carbide plastic-ramming material for use in the foundry; it has excellent resistance to thermal shock, and is resistant to corrosive attack from molten metals, slags, and most fluxes. The self-glazing properties of the 1,000 cement restricts oxidation when heated to a temperature of from 1,400 to 1,500 deg. C. in an oxidizing atmosphere. It can be used as a damp dust, a soft damp dust, or as a soft plastic. As a damp dust it is rammed behind formers; as a soft damp dust it is excellent for ramming, without formers, or for moulding shape parts; and in the plastic form it is useful for hand daubing and repairing cracks. Black Sal 2,000 is a plumbago stopper-plugging compound highly resistant to erosion.

Loading Shovel

F. E. Weatherill, Limited, Welwyn Garden City, have recently added to their range a mobile-industrial loading shovel, of half-ton lifting capacity, marketed as the "S.1." This miniature shovel shown in operation in a foundry (Fig. 1) is claimed to be highly manoeuvrable and whilst it can be operated under a ceiling as low as 6 ft. 3 in., the machine has the advantage of an exceptionally good forward reach, together with a discharge height that is adequate for loading tippers, and other trucks of normal height. Operator comfort and safety has received special attention, and a unique offset seating arrangement is provided which, together with the interesting single boom arrangement, successfully avoids the necessity of seating the driver between moving parts.

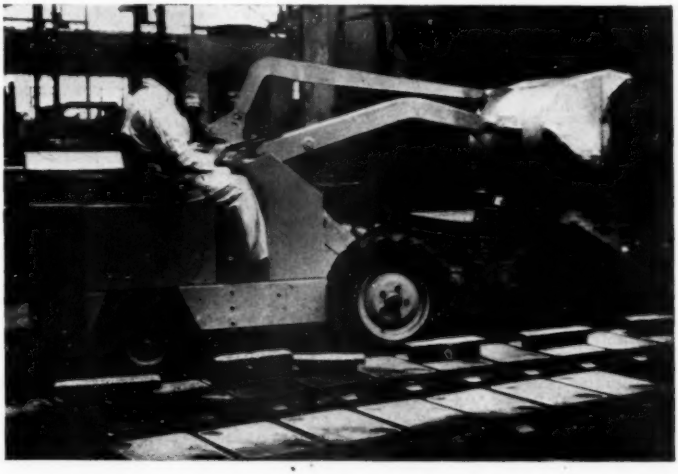


FIG. 1.—*Miniature loading shovel of half-ton capacity, manufactured by F. E. Weatherill, Limited, of Welwyn Garden City, shown being demonstrated in a foundry. The equipment is claimed to be highly manœuvrable within confined spaces, having a wheel base of only 4 ft. 9 in, whilst a ceiling height of 6 ft. 3 in., only, is required.*

Pre-coated Sand for Shell Moulding

Two years ago, the old-established sand supply firm of Buckland Sand & Silica Company, Limited, Reigate, Surrey*, initiated a comprehensive programme of research directed towards providing a high-grade pre-coated sand of consistent quality, for shell moulds and cores. After a period of laboratory tests, a pilot plant was erected and co-operation was obtained from a number of foundries willing to put the sands developed to practical test in the manufacture of their shell moulds and cores. The constructive criticism received was welcome and helpful, and it was evident that special precautions were necessary to ensure the consistency demanded. To obtain a really representative test sample of any bulk material is always a "headache," but the firm adopted a policy of sampling every hundredweight bag of each batch produced, until they were thoroughly satisfied with their control methods, and production for the general market has now commenced, the material being given the name "Resin-coat."

It is claimed that the relatively expensive phenolic resin applied by the system employed is used to maximum effect, making it possible to produce satisfactory shells and cores at a lower resin content and, therefore, at low cost. The raw sand used for coating is the firm's 50FG grade, a fine sand already established for shell moulding and similar work. It is reported that the new coated material has the known advantages of pre-coated sand—ease of stripping and freedom from segregation—and will operate satisfactorily using normal shell-moulding and core-production processes. The patternplate/corebox temperature found to give the best results is approximately 230 deg. C. Various grades are available of suitable strengths for cores and moulds used in the casting of light alloys, gun-metal and brass, grey iron and steel, in both light and heavy sections.

* Overseas enquiries are handled by the firm's agents, A. Elder Reed & Company, Limited, of 103 and 105, Battersea High Street, London, S.W.11.

TREND INDUSTRIAL EQUIPMENT, LIMITED, 5 The Ridgeway, Stanmore, Middlesex, main distributors for the Swiss-made "Lesto" pistol-grip drills, announce that they now have available a new ¼-in. drill with a speed of 2,500 rpm.

Metallurgical Progress

Abstracts of Recent Reports

A Survey of the Types of Furnace Atmospheres. C. H. VAUGHAN. (*Steel Processing and Conversion.* 1957. **43**; No. 2; pp. 96-103.) The author reviews some of the basic facts regarding atmospheres for industrial furnaces. The six atmospheres considered are exothermically-produced combustion gas, endothermically-produced combustion gas, nitrogen, dissociated ammonia, hydrogen, and argon and helium. Each of these furnace atmospheres is discussed briefly. It is noted that most of these atmosphere gases contain either hydrogen or carbon monoxide which, if permitted to mix with the air and be provided with ignition, are very explosive. On account of this, it is necessary to have a complete understanding of the safety features that can and must be provided. Another point stressed is that, regardless of how careful the atmosphere selection, how well designed the atmosphere-generating equipment, and how carefully it is controlled, the atmosphere within the actual furnace is the one that affects the parts being treated. It is essential for the design of the furnace and its operation and maintenance to be just as carefully considered. Proper atmosphere, the correct furnace equipment and efficient maintenance go hand in hand, but the furnace operator must be competent and well trained.

Steel Castings which are Resistant to Wear and Impact. C. G. MICKELSON. (*Iron Age.* 1957. **179**; No. 8; pp. 100-1.) Castings made from a new alloy steel show outstanding resistance to both wear and impact, when used in digging and crushing the flint-hard and highly-abrasive taconite-iron ores. Greatly improved service life has been obtained on heavy-duty crushers. The steel contains approximately 0.23 to 0.33 carbon; 1.3 to 1.8 manganese; 0.30 to 0.60 silicon; 0.40 to 1.00 chromium; 0.40 to 0.60 molybdenum; and 0.50 per cent. nickel (max.), also containing some boron. The treatment for developing the high-strength properties is not included. Standard test bars in the 500 Brinell-hardness range show these approximate values:—tensile strength, 245,000 lb. per sq. in.; yield strength, 190,000 lb. per sq. in.; elongation, 10 per cent.; reduction of area, 25 per cent.; impact strength, 22 ft. per lb. at room temperature, and 18 ft. per lb. at −40 deg. F. The alloy is magnetic which is useful in crushing or grinding certain refractory materials, for the abraded particles can be removed easily by magnetic methods. The alloy can be welded by conventional arc techniques, using proper electrodes and controlled pre-heating.

PLANS which will give Sunderland some of the finest quay accommodation on the north-east coast have been announced by Col. T. G. Greenwell, managing director of T. W. Greenwell & Company, Limited, shiprepairers, etc., of Sunderland. Work, which will take two years to complete, is to begin shortly on an 850-ft. long deepwater berth and quay capable of accommodating supertankers.

Publications Received

BCIRA Journal of Research and Development. Published by the British Cast Iron Research Association, Alvechurch, Birmingham.

All the material published in this issue consists of papers presented to the recent conference on the Engineering Properties and Uses of Iron Castings. It opens with a general paper by Dr. J. G. Pearce, who rightly brought in the question of the influence of trace elements and the trouble they could cause. Mr. Hallett's contribution threw much new light on the age-old question of co-operation between designer and foundryman and some of the examples he gave could, with profit, be included in textbooks still to be written. Mr. Colin Gresty in the discussion pointed out how very serious non-co-operation could be. He cited a case of where several foundries had lost money through just one ill-designed component.

The third paper reproduced was by Mr. G. N. J. Gilbert on "Factors Relating to the Stress/Strain Properties of Cast Iron." This is the type of paper to study in print, as it is not exactly elementary but is of basic scientific interest.

The fourth paper by Mr. A. G. Arnold and Mr. B. Todd dealt with their experience in using spheroidal-graphite iron for diesel engines and other marine-engineering applications. The paper registered a useful milestone in the successful use of this relatively new foundry material and indications were given of still further useful developments, one of which included the alloying with arsenic, a feature divulged in the discussion.

Switchgear castings were the subject of a paper by Mr. C. A. C. Hillyer and gave evidence of the wide extent of this field for cast parts. Mr. Handley gave illustrations of the potential dangers of light alloys when used in switchgear—particularly the fire hazard.

The final paper printed was by Mr. G. A. J. Begg who, dealing with "Large Iron Castings in One Branch of the Chemical Industry," dealt with the difficulties he had encountered in getting really satisfactory components. They came from jobbing foundries and it was suggested that here there was room for the employment of more technologists who could apply research results to good advantage.

This is a very good issue, full of good practical material of use to all founders.

BSI Annual Report, 1956-7. Published by the British Standards Institution, 2, Park Street, London, W.1; price 7s. 6d. net.

Excellent progress in practically every department of the British Standards Institution is reported for the year under review, and for the first time, the sales of British standards exceeded a million copies. The sole decrease was in the number of licences to use B.S.1 Certification Marks, which is to be deplored, as in general they give added substance to a specification. The report runs to over 270 pages and contains a wealth of information as to the activities of this vast organization.

Transport Age, Vol. 1, No. 2. Published by the British Transport Commission, 222, Marylebone Road, London, N.W.1.

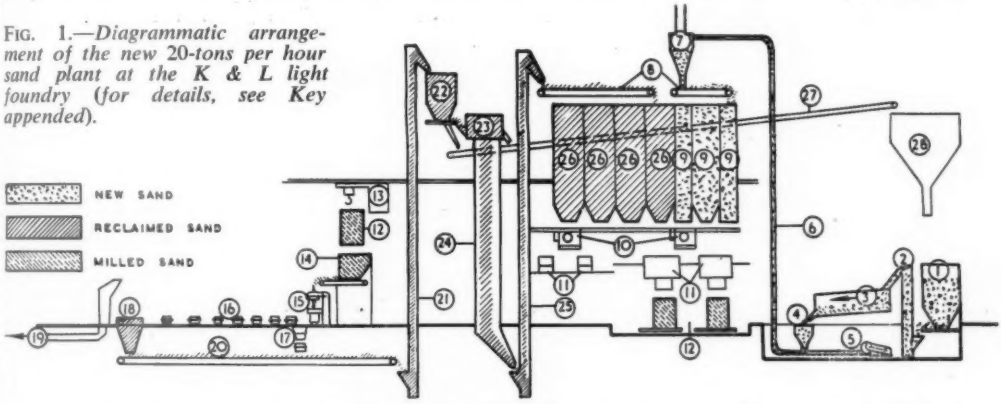
This second issue is equally as interesting as the first. It is illustrated in a manner equal to if not better than most "glossy" monthly publications, and covers the widest possible field—that is from Kinlochleven in the north of Scotland to the flower market of Cornwall. It is natural for railway people to have a sense of geography and this accounts for the very diverse matter selected for publication.

New Light Foundry at K & L

Steelfoundry Extensions Recently Completed in Letchworth

K & L Steelfounders and Engineers, Limited, have recently opened a light-castings foundry. The new building is situated to the east, and opposite the existing heavy foundry. It is a self-contained unit and gives an additional 70,000 sq. ft. of floor space. The three bays making up this 340 ft.-long building are 42 ft., 76 ft., and 30 ft. wide, respectively. Cranes are available in the largest bay, the height to the crane track being 24 ft. Colt ventilators are provided every 20-ft., on each side of the roof, and radiant-heating panels are being fitted. Most of the small repetition castings will be made in this unit, which will widen the range of carbon- and alloy-steel castings produced, without interfering with the production programme of the existing basic electric-arc melting furnaces. This re-arrangement has also made it possible to introduce an apprentice section in the main foundry, where a skilled moulder (of foreman status) supervises their instruction.

FIG. 1.—*Diagrammatic arrangement of the new 20-tons per hour sand plant at the K & L light foundry (for details, see Key appended).*



Key: (1) New-sand hopper; (2) elevator; (3) rotary sand dryer; (4) screen; (5) fan; (6) pneumatic elevator; (7) cyclone separator; (8) distribution belts; (9) dried-sand hoppers; (10) travelling weigh-hoppers (on overhead rails); (11) sand mills and coresand mixers; (12) sand skips; (13) monorail crane; (14) moulding-machine hoppers; (15) moulding machines; (16) mould conveyors; (17) spillage conveyor; (18) knockout and hood; (19) exhaust to wet collectors; (20) return-sand conveyor; (21) elevator; (22) sand hopper and disc feed; (23) rotary screen; (24) Colhep desilter; (25) elevator; (26) reclaimed-sand hoppers; (27) waste-sand conveyor, and (28) waste-sand and dust hopper.

Sand Plant

Of particular interest is the sand plant, designed and erected by K & L themselves, but incorporating certain standard units. A flow diagram of the new plant is shown in Fig. 1, two men only are required to run this plant. The new sand from a hopper is taken by elevator to a rotary sand dryer, passes through a screen and is then blown by means of a fan, to a cyclone collector high in the roof. From here, sand is delivered selectively by distributor belts into one of three storage hoppers, of which there is one of 70-ton and two of 30-ton capacity. From these, the sand is collected by travelling weigh-hoppers (Fig. 2) carried on a monorail to the Augusts No. 3F sand mills or the Fordath core-sand mixers, and then by monorail crane, in skips, to the moulding machines or core benches.

Used sand from the knockout travels on a returned-sand conveyor, passing through a magnetic separator to remove tramp metal, up an elevator to a used-sand hopper, through a rotary screen and into the vertical Colhep desilter (Fig. 3), and thence *via* a second elevator to the distributor belts to one of four 70-ton capacity hoppers. The returned-sand hoppers are alongside the new-sand hoppers and collection from them is made by the same travelling weigh-hoppers for transfer to the mills. Each hopper is fitted with pneumatically-operated discharge gates, controlled from the travelling weigh-hopper. This control device prevents hoppers being discharged when the weighing machine is not in the correct position to receive the charge. The air equipment for operating the discharge gates was supplied by Martonair, Limited.

In the south bay is the coreshop, which employs mostly female labour. Here cores are produced, mainly of oil-sand, and sprayed with a Zircon wash. There are the usual coreblowing machines (bench and vertical types) and other mechanical aids. The core-drying stove was supplied by Foundry & Engineering Company (West Bromwich), Limited; it has a drying cycle of

FIG. 2.—*Underside of the battery of new-sand and return-sand storage hoppers, showing collection and batching of material by rail-carried weigh car.*

FIG. 3.—*Colhep cooler and desilter; view taken from below showing the controllable-draught inlets at various levels.*

1 hr. 30 min. and a temperature range of 180 to 205 deg. C. There are ample storage facilities for cores.

Moulding and Knocking-out

To the left of the coreshop is a row of moulding machines. One of these is the 300-lb. jolt/squeeze Coleman Wallwork model WT.563, which takes boxes 18 by 12 in. The output of this machine at present, from one operator, is of the order of 150 boxes per week and production of castings up to 50-lb. weight as-cast can be accommodated. There are also four jolt/squeeze/pin-lift machines; these work in pairs and have a 3 to 5 minute cycle time. One pair handle boxes 24 by 24 in. and are capable of dealing with 440 boxes per week, whilst the second pair take boxes 24 by 18 in. and handle some 750 boxes per week. Both these pairs of machines are capable of handling up to 2¼-cwt. per box as-cast. Next to the moulding machines is the hopper for facing sand and a hand roll-over machine for coremaking. At the side of this machine are two further 1,400-lb. moulding machines of the jolt/squeeze/rollover Coleman Wallwork type WT.562D, taking boxes 24 by 24 in. and dealing with 450 boxes per week with a casting weight up to 3 cwt. (The production figures quoted relate, of course, to the machine utilization programme for the present time and may not reflect the maximum output or manning possible.)

Of particular interest in the centre bay are rows of inverted angle-iron tracks (Fig. 4), leading from the moulding machines. These are used for carrying light mould bogies and permit bank

FIG. 4.—*Floor-banked moulds awaiting pouring in the K & L light foundry. Note the angle-iron, floor-level tracks for carrying the moulds on light-weight bogies (one of the latter being shown separately).*

FIG. 5.—*Part of the "meat-hook" type of automatic shot-blasting plant (by Tilghman's).*

storage of moulds awaiting casting. It is claimed that they are very simple and cheaper to instal than roller track. Another advantage is that they run smoothly and reduce damage to moulds, and are generally considered as representing an advance on other forms of mould conveyor.

Transfer of the boxes from the moulding machines to the bogies is effected by pneumatic hoists (Martonair) on under-slung cranes furnished by British Monorail, Limited. At the other end of the bogie tracks, there are five knockout hoods, the exhaust from which is led to wet-type dust-collectors supplied by Air Control Installations, Limited. This knock-out ventilation consists of two "Rotoclones"—one of 16,000 cub. ft. per min. and one of 12,000 cub. ft. per min., giving 400 ft. per minute air velocity at the face of each hood.

K & L were pioneers in developing exothermic powders and these are widely used in the moulding sections to improve the feeding of the castings and increase the yield per cent. For the quantity production of small intricate castings, having thinner-than-average sections, Fairbairn Lawson Combe Barbour shell-moulding equipment is used. The output from this section is approximately 1 ton per week, mainly of stainless or other high-alloy steels.

The ingot section of this foundry produces high-quality ingots for forging and aircraft specifications. All ingots are bottom poured and feeder-heads are employed to ensure soundness. Ingots of 11½, 33, 54, 106 and 116 cwt. are produced, the total quantity being of the order of some 100 tons per week. To the right of the ingot section are the casting bays and to the left, the soaking pits. Here, ingots are soaked approximately three days, depending on their percentage of carbon.

Other Plant

In the north bay, there is a continuous shotblast plant. This is one of the few installations of its type in the country and is of Tilghman manufacture. It is operated by three men only and handles 5 to 10 tons of castings per hour. It consists of a continuous pendulum/chain conveyor (126-ft. long) (Fig. 5) carrying "meat-hooks" which follow a "U"-shaped course, passing four impeller-type blasting wheels. A shotblast casting is unhooked every minute and each hook can take up to 10 cwts., depending on the shape of the casting. All the shake-outs in this section are fitted with Air Control Installation's water-wash-type "Rotoclone" dust-extractors.

The total melting plant serving the heavy and light foundries consists of three, 5 to 7-ton electric-arc furnaces and two high-frequency units. The arc furnaces are basic lined and of the swing-roof type. Refining by oxygen injection is carried out as a routine practice. A novel fume-extraction system, made by Newton Collins, Limited (with the colloboration of K & L Engineers in its design), is installed in the foundry, the particularly efficient ventilation hood over the new 5/7-ton electric arc furnace being shown in Fig. 6.

All the arc furnaces are powered by 3,500 kva transformers and have automatic electrode operation by Amplidyne control. Platinum-platinum/rhodium thermocouples are used for measuring and recording the furnace temperatures. The furnaces have a cycle time of 2½ hours for each melt. Tapping is effected by controlled tipping into ladles suspended from overhead cranes. The furnaces have a high angle of tilting—up to 45 degrees by limit switch and up to 50 degrees manually. The high-frequency units are powered by a 600 kw. alternator-set with a 1,000 h.p. driving motor and operating direct from the high-tension supply system of 11,000 v. This power equipment serves one twin-bodied 25-cwt. unit and one 5-cwt. unit which can be fitted with a 2-cwt. body. Melting rate for the high-frequency furnace is such that a full charge of 25-cwt. can be melted in about

FIG. 6.—*New 5 to 7-ton electric-arc melting furnace; of particular interest are the exhaust hoods over the door and above the body.*

TABLE I.—*Typical Operating Data for K & L Melting Plant.*

5–7 ton Electric-arc Furnaces.

Furnace.	Lining.	Power input (kva).	Prod. rate refined steel, tons per hr.	Average weekly output (tons).		Electrode consumption lb. per ton.	Killowatt load consumpton, per ton.	Lining life.	Roof life.
				Castings.	Ingots.				
A	Basic	3,500	2.0	220	35	12.5	650	7 weeks	3 weeks
B	,,	3,500	2.0	220	30	12.5	650	7 weeks	3 weeks
C (Light fdy.)	,,	3,500	2.0	35	35	18.0	750	12 weeks	3 weeks

(A and B furnaces continuous working 6 a.m. Monday to 12.00 noon Saturday; C furnace 7.30 a.m. to 5.00 daily.)

High-frequency Units.

Capacity.	Lining.	Power.	Frequency.	Melting rate.	Weekly output.	Lining life.
25 cwt. .. .. 25 cwt. .. .. 5 cwt.	Acid or basic	600 kw	1,000 cycles	0.75 ton per hr.	40 tons per 44-hr. week	1 week

(Transformer input: 11,000 v.; output: 220 v., at 12,000 amp.)

1 hr. 20 min. Other operating details for the melting furnaces as a whole are recorded in Table 1.

At K & L, about 520 tons of liquid steel is melted each week; there is a casting total output of 215 tons per week, and it is hoped to build this up with the present facilities to 250 tons per week.

OVER 150 ENGINEERING COMPANIES are now participating in the Federation of British Industries' overseas scholarship scheme, which provides training with the companies for selected graduate engineers from the Commonwealth, South and Central America, and the Middle East. It is planned to extend the scheme to include countries in South-East Asia.

Salt-bath Graphitization applied to High-sulphur Irons*

By Olivier Bader and Daniel Godot

It is well known that the mechanical properties of a grey iron depend, on one hand, on the constitution of the matrix and, on the other, on the shape of the graphite disseminated throughout this matrix. Graphite, which forms and arranges itself at the moment of the solidification of the metal, crystallizes in a great many forms, but usually as flakes which vary as to size, division and shape, breaking-up the continuity of the matrix, which they weaken. The strains existing in the castings set up high-stress points in the bridges, surrounding the graphite flakes, which have no mechanical strength. Fatigue lines concentrated in these bridges (usually ferritic) can set up local cracking, which tends to cause embrittlement or fracture of the castings.

Modification of Graphite Shape

The form of the graphite has, therefore, a very important practical influence on the properties of grey irons and it is natural that a means to precipitate the graphite in a rounded or spheroidal shape, in the as-cast metal, was sought and subsequently developed. The magnesium/cerium process was developed to reduce the number of flakes and their lengths, and so raise the mechanical strength. It is also well known that the cementite Fe_3C met with in white iron is a metastable constituent which, at high temperature, decomposes into free carbon or graphite, as nodules according to the reaction $Fe_3C = 3\ Fe + C$ (graphite). The precipitated graphite can also have different aspects, lying between the spheroidal form when the base metal contains iron sulphide in the free state, and rounded aggregates of small particles when it contains manganese sulphide in the free state, with no iron sulphide present.

This reaction, through which cementite is converted into iron and carbon in the solid state, is the basis of the production of malleable cast iron and researches relative to this reaction are themselves limited to the type of iron used for this process. However, if certain conditions of composition and internal equilibrium are taken into consideration, it is possible to decompose this cementite almost instantaneously, according to the stable equilibrium diagram, by heating the metal in a liquid medium, to a temperature between 980 and 1,050 deg. C. for a short time.

The results to be divulged apply to a high-sulphur iron (made following a technique also described later) and are thought to have interest for malleable ironfounders and induce them to try out such a process, so that the annealing cycles can be reduced. It can be stated that the operating technique developed can be adapted to a problem, which the Authors have solved; that is to say, that the malleable iron to be made should be ferritic, with high elongation, or pearlitic, with a high tensile strength and average elongation (the most interesting properties in most lines of manufacture).

Industrial Graphitization

Graphitization, being the first stage in the cycle of malleablization in the manufacture of black-heart iron, was the starting point for the study of a new industrial process. The graphitization (malleablization) of white-iron castings is more often carried out (in France) in either pulverized-fuel- or tar-oil-fired furnaces. The castings are packed with spent ore in boxes which are then stacked in the furnace. The insulation of the boxes and the inert packing accordingly slows down the penetration of heat into the castings and imposes a prolonged delay in order to assure complete graphitization.

The more recent use of electric or radiant-tube heating, having the form of an elevator, bell, or tunnel, have speeded up graphitization through the creation of an atmosphere similar to that existing in annealing boxes. By these methods, boxes are no longer needed, nor means for their packing, and the requisite higher temperatures are more easily attained. The gaseous atmosphere made up of CO_2, CO, H and N is controlled during the operation so as to give a constant $CO:CO_2$ ratio, despite the release of carbon from the castings.

The aptitude to graphitization, when heating white irons, is known to increase with the temperature and the Authors have noted that the decomposition of cementite, under certain temperature conditions, was extremely rapid; this also depended on speed of the rise in temperature. Under these conditions, the slowness of cycles imposed upon the malleable-foundry industry is really appalling. How can the process be speeded?

The Authors have sought a practical and economic reply to this interesting question of the treatment of the graphitization of high-sulphur irons. Such irons are easy to cast with a white iron structure and thus, easy to decompose. The dilatation curve shows the rapidity of the graphitization of such a composition. Following this, it was thought best to carry out this graphitization in a liquid bath.

The liquid bath permits the possibility of obtaining rapid temperature rises, together with protection of the castings, against the inevitable oxidation to be associated with most of the other processes, and relatively high density (about 3), in the salt baths used, which being nearer to the

*Translated from a Paper presented to the 30th congress of the *Association Technique de Fonderie*.

weight of the castings protect them against deformation.

To carry out the method, the Authors used electrically-heated furnaces of the type which employs closely-spaced electrodes, immersed in the salt bath. The working temperature of this type of furnace permits its use for the graphitization process.

In the solid state, the salts are insulating and only become conductors when they are molten. To start the bath, it is necessary to melt a little of the salts between the electrodes, to allow the passage of a low-tension alternating current (5 to 25 v.). The layout is such that the electrodes set up electrodynamic energy in the interposed free space, whilst at the same time convection currents act on the rest of the bath; this assures, through a churning action, the rapid attainment of graphitization temperatures (980 to 1,050 deg. C.). The furnace containers are usually made of stainless steel, when used for cyanide baths, and refractory materials when neutral baths are utilized; the actual baths are made of a mixture of several salts and, according to composition, operate in very different temperature ranges.

At temperatures suitable for rapid graphitization, salts based on barium chloride (fusion point 800 deg. C.) with or without cyanide and other salt "correctors" such as sodium carbonate, chlorides, borax, etc., are used. The Authors have successively tried 5 to 75 per cent. $BaCl_2$ and 10 per cent. NaCn (*Durferrit*), with melting points of 980 (salts) 1,450; 787; 1,550, and 842 deg. C. as supplied by Houghton, between which they give a working margin of about 300 deg. C.

The salt bath graphitization can at first sight appear to be onerous, but is in truth quite economical; in fact, a quite large-output plant can be created from small-sized units, which can easily be adapted to automatic production.

In any case, the simplicity of the operation does not require the services of skilled labour, which is both in short supply and expensive. The furnaces operate at a constant temperature and as the interior of the furnace is not necessarily brought up to temperature during working hours, as is the case with the traditional processes for annealing malleable iron, raising to temperature being effected outside production time, can be slower and does not require means for superheating. The calorific power need only be sufficient for maintaining the furnace at temperature during actual working, and only the calories lost by removal of the hot castings have to be replaced. The losses are at a minimum, as the furnace can be efficiently insulated and the surface of the bath covered.

Conventional Method—Disadvantages

Conventional furnaces used generally require cyclic operation; castings are packed in boxes filled with iron ore and protected by a graphite-base coating; the atmosphere is difficult to render homogeneous and to control. Thermal inertia of the charge is high and consumption of calories is increased when raising an inert mass from room to graphitizing temperature. In the case of furnaces having controlled atmospheres, they need complicated plant and impose upon the user the choice and regulation of the atmosphere to be created.

Salt Bath—Advantages

With salt-bath furnaces, the loading and unloading is a continuous process; the preparation of the castings being made only a few moments before loading, and can be effected order by order. Upkeep is easy, a lid is pushed aside, the charge is removed and the lid immediately replaced. The operation lasts only a few minutes during which the heat losses by radiation are reduced to a minimum. The charge can be introduced either in baskets or suspended from hooks and lowered into the bath. It is possible to imagine the loading of the furnace by fractions, every quarter of an hour, so that the reduction in the temperature of the bath may balance the increase in temperature of the castings during the period of 15 minutes. The thermal exchanges are eight times quicker in a salt bath than in a gaseous media and Gorjunov has claimed that it is 71 times quicker than in a solid pack.

The skin of the castings is not oxidized as it is protected from the oxygen of the atmosphere by a light coating of solidified salt on their surface on leaving the furnace. These adhering salts can be readily removed by giving the casting a sharp tap; however, the castings must be carefully washed and dried to prevent subsequent corrosion.

The results given later, relate exclusively to high-sulphur irons, graphitized after 30 to 60 minutes, according to the section thickness of the castings tested, or test-pieces.

Cooling has been carried out either in (*a*) still air, (*b*) air blast, or (*c*) quenched in oil, and this can be followed by a stabilization or ferritization treatment in a second furnace which can be either a salt bath or some other type.

Thus, a very short time of graphitization, of the order of an hour; the possibility of loading and unloading small quantities at a time and at short intervals without the need of packing, are amongst the factors which permit of a rapid turnover of large quantities of castings by this method.

Graphitization of High-sulphur Irons

The first tests were carried out at 960 to 980 deg. C., necessitating a longer time for graphitization than the later ones where temperatures of 1,000 to 1,050 deg. C. were used. An iron of 2.36 carbon, 2.24 silicon and 0.20 per cent. of sulphur after 3 hours at 960 to 980 deg. C. in a bath of 6 to 8 per cent. cyanide gave the following results:—

(*a*) Cooled in still air—42 tons tensile, 1 per cent. elongation, 321 Brinell; (*b*) Cooled in air blast—45 tons tensile, no elongation, 340 Brinell; (*c*) Cooled in salt bath—61 tons tensile, no elongation, 415 Brinell, and, (*d*) Quenched in oil—21 tons

tensile, no elongation and 600 Brinell. The same test carried out on an iron with 2.58 carbon, 1.68 silicon and 0.20 per cent. sulphur, and cooled in still air gave 44 tons tensile, 1 per cent. elongation, and 321 Brinell. (The salt mixture is given, but refers to French proprietary compounds).

These tests showed the need to carry out graphitization at 990 to 1,000 deg. C., and to use a different type of salt bath and a refractory-lined crucible. An iron with 2.69 per cent. C., 1,57 Si., and 0.20 per cent. S. was completely graphitized in 45 min., the structure after cooling in still air was pearlitic with no trace of undecomposed cementite and gave 41 tons tensile with 2 per cent. elongation.

Experiments were then carried out using an Ajax furnace, which held 88 to 99 lb. of salts; the temperature fell to 920 deg. C., on introducing the whole of the charge, and 20 min. was taken to reheat to 1,000 deg. C. The time for graphitization was, on average, 1 hr. 30 min. Insulator caps so treated were broken under a load of 5 tons as against 2½ tons in the case of a malleable casting.

Tests from a bath made from salt at 960, after 50 min. duration gave:—

49 tons tensile, 2.5 per cent. elongation; (0.10 per cent. sulphur) and 46 tons tensile, 1.5 per cent. elongation (0.17 per cent. sulphur). Using salt No. 1450 the results were 48 tons tensile, 1.0 per cent. elongation (0.10 per cent. sulphur) and 41 tons tensile, 1.0 per cent. elongation (0.17 per cent. sulphur).

The Authors give an assurance that, when operating at a graphitization temperature of about 1.000 to 1,050 deg., an hour is the maximum time needed to graphitize castings of 0.60-in. in section; above that figure the time must be increased. From the structural point of view, the Authors have occasionally encountered a small ferritic band (picture frame) and paradoxically it appeared when using a mixture of cyanide salts.

Conclusion

The Authors have been able to obtain, using high-sulphur irons, excellent commercial results when employing two stages, *viz.* (1) graphitization in salt baths at 1,050 deg. C., and (2) transferring to an atmosphere-controlled, tar-oil-fired furnace for partial ferritization between 760 and 720 deg. C. at the rate of 5 deg. C. per hour. The results regularly obtained in this instance are 6 to 8 per cent. elongation, with 38 to 41 tons per sq. in. tensile. The treatment applied to insulator caps, covers and other small castings required 50 min., for graphitization, and 8 to 10 hours for ferritization.

The Authors conclude by stressing the advantages of graphitizing castings by rapid heating to 1,000 deg. C.; these conditions are brought about economically in a salt-bath furnace, since everybody realizes the difficulties that have to be overcome in the conventional type of furnace, and the results shown in the shape and appearance of the castings so annealed.

The tests, to establish this process, were carried out in the foundries of Mr. R. Theret, to whom the Authors express their gratitude for permission to publish the paper. They also thank the firm of Ugine Infra of Grenoble, which kindly placed at their disposal an installation of salt-bath furnaces, for perfecting the heat-treatment process.

British Aluminium Company's Expansion

For the development of interests overseas, the British Aluminium Company, Limited, is to raise £5,800,000. Ordinary stockholders registered on July 9 will have the right to take up 2,000,000 £1 ordinary shares at 58s. each, on the basis of two for every £7 of stock.

Up to £2,000,000 of the new capital will go to the Canadian British Aluminium Company to develop the Baie Comeau project in Quebec. Pouring of the first ingot is expected at the end of this year or early next, and from then on it is aimed to reach a maximum rate of 80,000 tons a year by the summer of 1959. Further stages will double that amount. To maintain that rate of production a direct interest in the production of additional supplies of alumina is considered essential. A 10 per cent. interest has, therefore, been taken in Fria, Compagnie Nationale pour la Production d'Alumine, formed in French Guinea to establish a new source of alumina production in West Africa. British Aluminium's capital share in that company will be of the order of £3,500,000 and the first stage of the product is designed to produce annually some 480,000 metric tons of alumina of which 10 per cent. will be available to British Aluminium.

A 50/50 share is also being taken with the Consolidated Zinc Corporation in the Commonwealth Aluminium Corporation of Australia, in connection with the projected development of extensive bauxite deposits in the north of Queensland.

With the raising of new capital, stockholders are informed that in the last year, two American companies, the American Metal Company and Climax Molybdenum Company, have become stockholders. Their holdings, it is understood, do not amount to a controlling interest.

Hazards of Compressed Air

New regulations to ensure close attention to the health and safety of those working in compressed air and, in particular, correct control and supervision of procedures both in compression and decompression, are contained in statutory draft regulations published last Friday by the Minister of Labour. The statutory draft allows organizations and individuals to consider the requirements and raise any points with the Ministry.

"Caisson disease"—usually known as "the bends"—is the most common hazard arising from incorrectly controlled decompression and it can lead to permanent disability or death. The draft regulations, "The Work in Compressed Air Special Regulations, 1957," is obtainable from the Stationery Office or through any bookseller, price 8d. net (10d. post free). Representations should be made to the Secretary, Ministry of Labour and National Service, 8, St. James's Square, London, S.W.1.

British Blast Furnaces in the June Quarter, 1957

(These tables are published through the courtesy of the British Iron and Steel Federation.)

Derbyshire, Leicestershire, Notts, Northants, and Essex.

Name of firm.	In blast at end of the second quarter, 1957.					Weekly average in blast.	Total existing at end of quarter
	Hematite.	Basic.	Foundry and forge.	Ferro-alloys.	Total.		
Clay Cross Co. (Iron & Foundries)	—	—	1	—	1	1	2
Ford Motor	1	—	—	—	1	1	1
Holwell Iron	—	2	1	—	3	3	4
Kettering Iron & Coal	—	—	2	—	2	2	2
New Cranaley Iron & Steel	—	1	—	—	1	1	2
Renishaw Iron	—	—	2	—	2	2	2
Sheepbridge	—	2	—	—	2	2	2
Stanton Ironworks: Stanton-by-Dale	—	1	3	—	4	4	5
Staveley Iron & Chemical	—	—	4	—	4	3.5	4
Stewarts and Lloyds: Corby	—	3	—	—	3	3.8	4
Wellingboro' Iron	—	2	—	—	2	2	3
TOTAL	1	11	13	—	25	25.3	31

Lancashire (excl. N.-W. Coast), Denbighshire, Flintshire, and Cheshire.

Brymbo Steel	—	1	—	—	1	1	1
Darwen & Mostyn	—	—	—	1	1	1	2
Lancashire Steel Corporation	—	2	—	—	2	2.6	3
Summers, John	—	2	—	—	2	2	2
TOTAL	—	5	—	1	6	6.6	8

North-West Coast.

Barrow Ironworks	3	—	—	—	3	3	4
Charcoal Iron	—	—	1	—	1	1	1
Millom & Askam Hematite Iron	2	—	—	—	2	2	2
United Steel: Workington	2	—	—	1	3	2.4	3
TOTAL	7	—	1	1	9	8.4	10

Lincolnshire.

Appleby-Frodingham Steel	—	3	—	—	3	3.7	4
Lysaght's Scunthorpe Works	—	3	—	—	3	3	4
Thomas, R., & Baldwins: Redbourn	—	3	—	—	3	3	3
TOTAL	—	9	—	—	9	9.7	11

North-East Coast.

Consett Iron	—	3	—	—	3	2.9	3
Dorman Long (Steel): Acklam	—	2	—	—	2	2	4
Redcar	—	2	—	—	2	2	2
Bessemer	—	1	—	1	2	2	3
Clay Lane	—	2	—	—	2	2	2
Gjers Mills	2	—	—	—	2	2	5
Normanby Iron Works	2	—	—	—	2	2	3
Skinningrove Iron	—	2	—	—	2	2	3
South Durham Steel & Iron: West Hartlepool	—	2	—	—	2	2	2
Cargo Fleet	—	3	—	—	3	2.2	3
TOTAL	4	17	—	1	22	21.1	30

Scotland.

Bairds & Scottish Steel: Gartsherrie	1	1	1	—	3	3	4
Carron	—	—	1	—	1	1	4
Colvilles: Clyde Works	—	3	—	—	3	3	3
Dixon's Ironworks	—	2	—	—	2	2	6
TOTAL	1	6	2	—	9	9	17

South Wales and Monmouthshire.

Briton Ferry Works	1	—	—	—	1	1	1
Guest Keen Iron & Steel: Cardiff	1	2	—	—	3	3	4
Thomas, R., & Baldwins: Ebbw Vale	—	3	—	—	3	3	3
Steel Company of Wales: Margam	—	4	—	—	4	4	4
TOTAL	2	9	—	—	11	11	12

Expanded Output

August Thyssen Huette, AG, Duisburg-Hamborn, blew in its seventh blast furnace last month. It is capable of producing 1,100 to 1,200 tons of iron per day and brings the company's iron production from 130,000 to 160,000 tons per month. ATH is now the third biggest maker of pig-iron in west Germany. About 6,000,000 tons of iron have been smelted in Hamborn since May, 1951, 800,000 tons of it since January this year. The works started up in May, 1951, after a six-year shut-down.

An eighth blast furnace with a hearth diameter of 29 ft. 6 in. and a daily output of 1,500 tons was announced at the blowing-in. The managing director, Dr. Michel, considered that there was no reason for having smaller blast furnaces in west Germany than in the US or the USSR. German blast furnaces must be built in the most economical way possible, particularly when it was realized that ores came from overseas and even coal was coming from the US.

When the size and output of blast furnaces increased, the investment costs as well as the operating costs per ton of steel diminished. A blast furnace of 1,500 tons daily output only needed 70 per cent. of the investment, and half the manpower, of two 750-ton furnaces. The present ATH output of 130,000 tons per month could comfortably be made by three large furnaces, and the firm had decided therefore that its eighth blast furnace would be one of the largest in the world, with a daily output of at least 1,500 tons.

BCIRA Hot-blast Cupola

An order has been received by the engineering division of Newton Chambers & Company, Limited, Thorncliffe, near Sheffield, from the British Cast Iron Research Association for an experimental hot-blast cupola installation at Alvechurch, near Birmingham. This will incorporate the Inka radiant-type air preheater for which Newton Chambers have recently concluded a licence agreement with Industriekemiska Aktiebolaget of Stockholm.

The contract with BCIRA was negotiated by Newton Chambers jointly with the Constructional Engineering Company, Limited, of Birmingham, who will be responsible for the installation of the cupola and certain other ancillary equipment.

British Blast Furnaces in the June Quarter, 1957—*continued*

Staffordshire, Shropshire, Worcestershire, and Warwickshire.

Name of firm.	In blast at end of the second quarter, 1957. Hematite.	Basic.	Foundry and forge.	Ferro-alloys.	Total.	Weekly average in blast.	Total existing at end of quarter.
Goldendale Iron	—	—	1	—	1	1	2
Lilleshall	—	—	1	—	1	1	2
Round Oak Steel Works	—	—	—	—	—	—	2
Shelton Iron & Steel	—	3	—	—	3	3	3
Stewarts and Lloyds : Bilston	—	2	—	—	2	2	3
TOTAL	—	5	2	—	7	7	12
Sheffield.							
Park Gate Iron & Steel	—	1	—	—	1	1.1	2
GRAND TOTAL	15	63	18	3	99	99.2	133

Weekly Average Number of Furnaces in Blast during the June Quarter, 1957, and the Previous Four Quarters

District.	1956. June.	Sept.	Dec.	1957. March.	June.
Derby, Leics., Notts., Northants and Essex	24.9	26.6	27	26.1	25.3
Lancs. (excl. N.-W. Coast), Denbigh, Flint, and Ches.	7	6.9	7	6.8	6.6
Lincolnshire	9.5	9.2	9.1	10	9.7
North-East Coast	21	20.2	19.8	19.5	21.1
Scotland	9	9	9	8.5	9
Staffs., Shrops., Worcs., and Warwicks	7	7	6.6	7	7
S. Wales and Monmouth	9.8	9.6	10.3	9.9	11
Sheffield	2	2	2	2	1.1
North-West Coast	9	9	8.2	8.6	8.4
TOTAL	99.2	99.5	99	98.4	99.2

The following companies have furnaces in course of construction or rebuilding:—Millom & Askam Hematite Iron; Colvilles; Lancashire Steel Corporation; Steel Company of Wales.

Lighting in Industry

Illumination in industry is an important enough matter to justify a new 31-min. film "New Light on Industry," which has just been made about it by the British Electrical Development Association, 2, Savoy Hill, London, W.C.2. An industrialist, planning a new factory, is seen discussing its illumination with a doctor, a welfare officer, a lighting engineer, factory workers and others. Viscount Chandos consented to appear in the film, and added to its point by pleading for bright and light colours in workshops.

A particularly attractive lighting method shown in the film is the luminous ceiling used by a firm of instrument makers. This consists of an obscured-glass false-ceiling which hides the lighting fittings, and thus gives a pleasant diffused illumination, which is, in effect, an artificial sky. The power cost of one industrial lighting scheme was as little as 10s. per hour for 2 acres of workshops. EDA is willing to lend the film free of charge, or to sell prints of it to those interested.

A PUSH-BUTTON INDICATOR MAP installed at the Midland Railway Station, Derby, lights up the position of industrial and commercial firms in the town, addresses and telephone numbers are also given. Credit must be given to the Derby and Derbyshire Junior Chamber of Commerce for its installation, which should save business men time when they wish to locate a local firm without delay.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

BURMA, August 19—Quantities of cast-iron rainwater pipe and guttering. (ESB/19035/57.)

CANADA, August 20—Circulating water pumps for the Manitoba Hydro-electric Board. (ESB/18451/57.)

FORMOSA, September 3—Machine tools and welding equipment for ICA procurement. (ESB/18965/57/ICA.)

FORMOSA, September 2—Woodworking tools for ICA procurement. (ESB/18953/57/ICA.)

IRAQ—Machinery for pumping station. (ESB/18394/57.)

IRISH REPUBLIC—Supply and laying of cast-iron water main. (Deposit £10 10s.) (ESB/18186/57.)

SOUTHEND-ON-SEA, August 22—Construction of 3¼ miles of 9-in. dia. spun-iron main. Deposit £2. Borough Engineer and Surveyor, Municipal Buildings, Southend-on-Sea.

SOUTH AFRICA, September 6—Air compressors for the Stores Department of the South African Railways. (ESB/19057/57.)

SOUTH AFRICA, August 29—Cast-iron gas governors for the City of Johannesburg. (ESB/19158/57.)

SOUTH AFRICA, August 23—Air compressors for the Transvaal Provincial Administration. (ESB/19148/57.)

SOUTHERN RHODESIA, August 22—Electrically powered sandpapering machines. (ESB/19370/057.)

AITON & COMPANY, LIMITED, power-pipe engineers, of Derby, are to supply plant to the value of nearly £2,000,000 for High Marnham Power Station of the Central Electricity Authority.

Company News

TWEEDALES & SMALLEY (1920), LIMITED, textile machinery manufacturers, of Rochdale (Lancs)—In view of the offer by the controlling company, Platt Bros. & Company (Holdings), Limited, to acquire the outstanding shares, it is stated that payment of an interim dividend for 1957 should be considered when the time limit for acceptance has expired. The offer has been declared unconditional.

JAMES BOOTH & COMPANY, LIMITED, non-ferrous metal manufacturers, etc., of Birmingham—An offer has been received from the Delta Metal Company, Limited, to acquire all the ordinary shares on the basis of the allotment of two Delta 5s. shares for every one Booth £1 share. The offer is receiving consideration and a further announcement will be made as soon as possible. The company has £1,500,000 in ordinary in issue.

RANSOMES & RAPIER, LIMITED, engineers, iron-founders, etc., of Ipswich (Suffolk)—Applications for the issue to ordinary shareholders of 228,000 10s. ordinary shares at par totalled 380,152. Over 97 per cent. of shares due by way of rights have been subscribed for, and application made for 157,849 for excess shares. Allotment of the remaining 5,697 excess shares has been made *pro rata* to existing holdings.

CHARLES NEIL & COMPANY, LIMITED, manufacturers of engineers' and joiners' tools, of Sheffield—The offer by Hackwood Nominees to purchase the company's shares at 13s. 6d. each has been accepted by holders of over 90 per cent. of such shares and has become unconditional. Hackwood Nominees intends to implement the provisions of the Companies Act to acquire the remainder of the Charles Neil holding.

FIRTH BROWN TOOLS, LIMITED—Reporting group profits, before tax, of £579,722 for the year ended March 31, compared with £643,663, the chairman, Lord Aberconway, says that deliveries were somewhat larger both in volume and value, in the face of highly competitive conditions, and export sales were successfully maintained, but costs continued to rise without proportionate increases in the prices obtainable. The dividend is 11½ per cent. on the increased capital, against 12½ per cent.

NEWMAN, HENDER & COMPANY, LIMITED, iron and non-ferrous founders, etc., of Stroud (Glos)—A final dividend of 20 per cent. is declared, making 25 per cent. for the year to March 30, 1957, on capital increased to £444,733 by a two-for-five rights issue, a rise of 5 per cent. over the total on the smaller capital for 1955-56. Group profits increased by nearly £55,000 to £418,163, but this was almost entirely offset by heavier taxation, leaving the balance little changed at £180,384 (£179,225).

ANTI-ATTRITION METAL COMPANY, LIMITED—The offer by Beyer, Peacock & Company, Limited, to acquire all the issued shares of the company has been extended until August 23. Beyer, Peacock & Company reports acceptances of over 50 per cent. of the shares of Anti-Attrition and declares its offer unconditional. Resolutions were passed at last week's meeting of Anti-Attrition approving compensation payments for loss of office to Mr. M. J. B. Whitby (£3,000) and to Admiral Sir Maurice Mansergh (£500). These directors are retiring from the board in order that Beyer, Peacock may appoint four directors.

WILMER LEA FOUNDRIES (HOLDINGS), LIMITED—The company's prosperity depends on its ability to diversify its activities because of the large surplus of capacity over demand that has developed in the industry and is likely to continue to develop. The difficult conditions are reflected in the substantially lower sales turnover and profit margins in the year to March 31, 1957. During the first few months of the current year the foundry subsidiary has been operating at considerably reduced output and one major production unit has been closed since May 4. The group net profit is £8,395 (£16,964) and the ordinary dividend 4 (6) per cent.

EDGAR ALLEN & COMPANY, LIMITED, steelmakers, of Sheffield—Outstanding commitments of £99,524 form part of a total expenditure of about £300,000 envisaged during 1957-58. About one third is for modernization of the steelfoundry on which some £70,000 has already been spent. The influx of orders gives ground for confidence that the current year's sales will be as good as, if not better than, those in the year ended March 30 last. In the engineering section deliveries on the contract for cement-making plant for Iran (of nearly £1,000,000) would make a substantial contribution to turnover during the current year and beyond.

H. J. ENTHOVEN & SONS, LIMITED, lead smelters and refiners, etc., of London, E.C.4—An offer by the Consolidated Zinc Corporation, Limited, to acquire 75 per cent. (with an option to purchase the remaining 25 per cent. in two years) of the share and loan capital of the subsidiary, Pure Chemicals, Limited, has been accepted by the directors. Mr. A. M. Baer, chairman, who is also deputy chairman of Consolidated Zinc, points out that the trading losses of the subsidiary, part of which were in the nature of development expenditure, had been written off the group profit and loss account in the consolidated balance-sheet at December 31, 1956. The amount realized from the sale of 75 per cent. of the company's interest now leaves the book value of the remaining investment in Pure Chemicals at a figure which is below the amount receivable if the option is exercised, he declares.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s. 6d.)

776,031. Stanton Ironworks Company, Limited, P.O. Box No. 3, Near Nottingham.

Apparatus for blowing cores for castings, which includes a vessel from which sand is driven in a stream of air from a corebox beneath. One or more rotary stirrers are placed on horizontal, rotary shafts which each pass completely across the vessel. Practically all the sand is, therefore, agitated by the stirrers. A hopper is also provided for replenishing the vessel.

776,091. Buders'sche Eisenwerke, Wetzlar, Germany, and Stanton Ironworks, Limited, P.O. Box No. 3, Near Nottingham.

Plant for the centrifugal casting of hollow bodies or of covering, protecting of similar layers in hollow bodies.

776,095. Kelsey-Hayes Company, 3,600, Military Avenue, Detroit, Michigan, USA.

Sand mould for foundry use of the type having a flask and a diaphragm movable downwardly. It is constructed so that during a moulding operation a pouring cup form can be displaced to form a pouring cup in the mould sand. A tubular member is provided for the escape of sand through a patternplate during the forming of the pouring cup and forming a sprue in the sand in communication with the pouring cup.

Book Reviews

Steel Foundry Practice by John Howe Hall. Published by the Penton Publishing Company, Cleveland, Ohio. (Obtainable in this country from the Penton Publishing Company, Limited, 2, Caxton Street, Westminster, London, S.W.1; price $12 (or £4 16s. in UK), plus postage.)

The author of this text will be known to many British readers of American technical literature as the writer of many articles on foundry practice. He had earlier written a book entitled "The Steel Foundry," which was published in 1914, and his association with the American steelfounding industry extended over a period of almost 50 years. The present work was published posthumously and is consequently the author's last contribution to the literature of the founding industry.

Obviously Mr. Hall had excellent qualifications to write an authoritative text on a subject with which he had a life-long connection, and he has succeeded in writing an eminently readable and almost "chatty" book, which touches in more or less detail on most subjects of interest to the steelfounder. Five chapters are devoted to sands, patterns, moulding methods and machines, gating and heading. There are chapters on centrifugal casting, dressing operations and heat-treatment, three chapters on steelmaking and one on ladle practice.

In spite, however, of the fact that the book contains many valuable features, the reviewer would be failing in his duty to potential readers in this country if he did not draw attention to some shortcomings and omissions. Perhaps the most serious criticism is that which appears to the present reviewer to detract from the quality of a very high proportion of American texts. This is the tendency to ignore almost completely all work conducted outside the North American continent. In the first 284 pages of the book reference is made to only one "foreign" author, and his name is spelt incorrectly! The value of the book should be gauged with this fact as a background, and it is probably true to say that the greatest use of this book to a British reader will be as a guide to *American* steelfoundry practice.

In some respects individual chapters in the book lack balance. Some matters are referred to in considerable detail, while others receive only cursory attention or are omitted altogether. For example, in the first two chapters, which refer to moulding sands and methods, the cement-sand process is described with a detail which seems excessive in view of the limited use made of this technique, while in discussing the properties of clay-bonded sands only "green" and "air-set" strengths are considered and no mention at all is made of dry-strength, flowability or refractoriness. Little reference is made to the properties of moulding materials at high temperatures and mould paints and washes are dismissed in half a page. Other notable omissions are any references to the CO_2/sodium-silicate process or to the use of zircon sand as a moulding material or as a base for mould paints. Although passing reference is made to methods of sand reclamation, the dry pneumatic scrubbing method is not mentioned at all, in spite of its American origin.

The chapter on moulding machines is in some ways excellent, but many readers will be disappointed that high-pressure and diaphragm moulding methods are both ignored. An even more surprising omission is the subject of shell moulding. Similarly, in discussing dressing operations, the air/carbon-arc torch is summarily treated, while powder-washing is ignored.

More attention could have been given, with profit to the reader, to the editing and sub-titling. For example, under the sub-title "Oxy-acetylene Cutting Torch" the text deals principally with feeder heads and not with torches. The use of more illustrations, notably line drawings, to show the principles involved in the various moulding processes, would have been of great value to the general reader.

In general the book will have some value for the student reader, provided he is not looking for information on the most recent developments in steelfoundry practice. The practical foundryman may find something of specific interest in the chapters on "Moulding Methods," "Gates and Heads" and "Flasks and Rigging," but for a general authoritative text on steelfounding the reviewer and many readers will continue to rely on other books on this subject; from one of these, of American origin, a number of the illustrations in the present book appear to have been taken.

A. H. S.

Practical Microscopical Metallography, by R. H. Greaves and H. Wrighton (4th edition). Published by Chapman & Hall, Limited, 37, Essex Street, London, W.C.2; price 70s. net.

This is a very disappointing book because the authors have not kept up with the times. Many of the chapters are almost identical with the corresponding chapters of the 1924 edition, and still more like the corresponding chapters of the 1939 edition. The first chapter is indeed identical with the corresponding chapter of the 1939 edition except that a typographical error has crept in and "true" has been spelt "turn."

As before, the second, third and fourth chapters deal with the preparation of specimens for microexamination, the microscope itself and methods of microscopic examination, and with low-power photomicrography and macrography respectively, and further special techniques are briefly described in chapter XVIII.

During recent years there have been many advances in metallographic practice, but the authors scarcely refer to any of them and in particular their references to polishing are many years out of date. For some years it has not been necessary to use Hubert's *qualité supérieure* French emery papers, as many other types are now available. Furthermore, it is not now usual to use a plentiful supply of polishing medium as recommended by the authors; one usually uses very little.

The method of electrolytic polishing described entails finishing the surface on 000 emery and then electrolytically polishing for 15 to 30 min. Electrolytic techniques are now so efficient that it is only necessary to finish the surface on say 0 emery, after which it can then be electrolytically polished and etched in not more than say 20 sec. The special techniques in metallurgical microscopy, *viz.*: polarized-light microscopy, phase-contrast microscopy, light profile and interferometry are briefly described in chapter XVIII which consists only of nine pages inclusive of four diagrams.

Chapter V deals with the structure of pure metals and of alloys, whilst VI to XI deal with the metallography of iron, steel, cast iron, etc. Chapter XII deals with the effect of impurities in copper. Chapters XIII to XVII deal adequately with the structure of alloys of copper, zinc, tin, silicon, aluminium, nickel and with alloys of nickel, copper, iron and chromium, with the structure and properties of alloys of aluminium and of alloys of magnesium. The practical notes on the polishing and etching of the alloys, however, leave much to be desired. The book concludes with an index of photomicrographs and a subject index.

J. F. K.

News in Brief

AN INRUSH of water from an adjoining brook on August 7 held up production at the Scunthorpe works of Richard Thomas & Baldwins, Limited.

THE SHEFFIELD OFFICE of Derby & Company, Limited, ferro-alloy manufacturers, will move to 4, London Road, Sheffield 2, on September 2. The new telephone number is 28879.

THE Solartron Electronic Group, Limited, Thames Ditton (Surrey), has decided to sell no longer through agents in the UK. In future, all inquiries should be sent direct to the group at the Thames Ditton headquarters.

LAST YEAR, for the first time in the firm's history, vehicles of the Stanton Ironworks Company, Limited, near Nottingham, carried over 1,000,000 tons, and 92.8 per cent. of the drivers qualified for safe-driving awards.

THE US GOVERNMENT Export-Import Bank recently announced a $10,300,000 (about £3,771,000) loan for the expansion of a Japanese steel company. It is the first loan from the bank to a steel mill in the Far East.

THE AIR TOWEL DIVISION, of the Spiral Tube & Components Company, Limited, Osmaston Park Road, Derby, are using a specially built van in order to demonstrate at the actual works, the efficiency of their "Air Towel" unit.

AN OMISSION OCCURRED in last week's edition of the JOURNAL, in the footnote to the Leader, on page 151; the price of the "Factories Ionizing Regulations," which was omitted, is 11d. post free, as was published in the footnote on page 175.

THE UNIVERSAL ASBESTOS MANUFACTURING COMPANY, LIMITED, of Watford, states that it is obliged to increase the prices of its asbestos cement products by a general average of 7½ per cent., with effect from August 6. The change has no bearing on export prices.

MACKENZIE & MONCUR, LIMITED, Balcarres Street, Edinburgh, 10, announce that in view of their increasing business in the Glasgow area, they have acquired new and larger premises at 453, Pollokshaws Road, Eglinton Toll, Glasgow, S.1. (Telephone: Glasgow POLlok 1333.)

EXTENSIONS to the Imperial College of Science and Technology, South Kensington, London, will mean the demolition of the present buildings of the Imperial Institute. A new site in Holland Park has been found for the Institute, and negotiations for a building lease are at an advanced stage.

A SAW made by Spear & Jackson, Limited, Sheffield, has been in use by the family of Mrs. Charles Peters, Illinois, USA, for 122 years. Mrs. Peters has written to the firm stating that the saw was used by her great-grandfather and great-uncle, who travelled in a covered wagon to settle in the State.

THE Lead Development Association states that the affairs of the Lead Sheet and Pipe Council have been integrated with those of the LDA with effect from July 1 last. The Association has formed a lead-sheet and pipe section, on the committee, of which members nominated by the Lead Sheet and Pipe Manufacturers' Federation will serve.

A ONE-DAY CONFERENCE on "Recent Developments in Industrial Low-temperature Gas Separation" will be held at the Royal Institution, London, W.1, on November 26. The organizers are the Low Temperature Group of the Physical Society, and the Institution of Chemical Engineers.

WITH THE THEME of "Research—a Signpost to Better Management," a national conference is being arranged by the British Institute of Management, to take place at Bournemouth from November 6 to 8. This 12th conference arranged by the BIM is the first to be held by the new institute formed by the integration into the BIM of the Institute of Industrial Administration.

DAWSON BROS., LIMITED, bottlers' engineers, Gomersal, near Leeds, have delivered by direct road transport from their works to a firm in Brussels, a 24-ft. long bottle-washing machine, weighing about 14 tons. It was conveyed to Tilbury on a trailer, where both trailer and machine were put on an Antwerp-bound ship, and taken on to Brussels by an international firm of hauliers. The machine will be ready for use immediately on arrival.

THE AUSTRALIAN AGENT of the Metropolitan-Vickers Electrical Company, Limited—Australian Electrical Industries Proprietary, Limited—has secured a £4,400,000 order for the new power station at Yallourn, Australia. The order was placed by the State Electricity Commission of Victoria. Both companies are members of the Associated Electrical Industries group. The contract is for the complete power station with the exception of the boilers and coal-handling plant.

STAR FOUNDRY COMPANY, LIMITED, of Bradley, Bilston, Staffs, have equipped a children's playing field in Coseley at a cost of about £1,000. Last week it was officially opened by the chairman of the local Council. Next September, the company will celebrate the fortieth anniversary of its foundation and it is interesting to note that the founder directors, Mr. W. R. Purdy and Mr. G. T. Gough, are still active in the affairs of the company, the former as chairman and managing director.

YORKSHIRE ENGINEERING COMPANY, LIMITED, Sheffield, a branch of the United Steel Companies, Limited, has received an order worth over £100,000 from the African Manganese Company for three new-type diesel locomotives. These are of the Janus type, powered by two 200-h.p. Rolls-Royce diesel engines which face in opposite directions. The locomotive is thus "double-headed" and the driver's cab is in the centre. The engines are for use in British Guiana and will be used on a 37-mile track to a new mining development site.

CONSTRUCTION of the £37,000,000 nuclear power station at Hunterston, Ayrshire, has been approved by the Government. The station will be built for the South of Scotland Electricity Board by the G.E.C. Simon-Carves atomic-energy group, which includes the Motherwell Bridge and Engineering Company, Limited, and John Mowlem (Scotland), Limited. When completed the station will be the largest of its kind. The buildings containing the two reactor-furnaces will each be 202-ft. high and about 600-ft. long; the turbine hall between them will be 70-ft. high.

NEWTON CHAMBERS & COMPANY, LIMITED, Thorncliffe Works, Sheffield, have almost completed the construction of a pilot plant which will increase the amount of motor spirit that can be secured from refining tar from eight to 18 per cent. The firm has secured the world rights for making and marketing the plant which is the result of five years' research by the Coal Tar Research Association. The pilot plant will be able to deal with 500 tons of tar a day, enough for market research and investigation. It is claimed that the motor spirit will be purer and less sulphurous.

American Stainless-steel Melting Practice

This short paper, of more general interest to founders, describes the process for the recovery of chromium, manganese and iron, which enter the slag during stainless-steel melting, and concludes with a summary of the factors for optimum recovery of these elements.

The methods and materials used to accomplish slag reduction vary somewhat with the size of furnace, type of operation, and economic factors. Slag reduction is practised primarily to recover valuable quantities of chromium, manganese, and iron which enter the slag during the removal of carbon from the bath. The value of these elements and their affinity for oxygen decreases in the order listed. Thus, before the expensive chromium-units can be separated from the oxide a considerable portion of the manganese and iron oxides must be reduced. This is accomplished by the addition of metallic reducing agents, more expensive than the iron and sometimes more expensive than the manganese-units.

Factors

Physical and operational factors influence the completeness of slag reduction. This problem begins with the charging and oxidation practice. The amount of stainless-steel scrap charged, the temperature of the bath at the beginning of the oxygen blow, and the length of the intensity of the oxygen blow, all markedly influence the volume and composition of the slag before reduction. Much can be done to minimize the slag-reduction problem by a charging and oxidation practice which results in a low-slag volume and a minimum amount of chromium oxidation during carbon removal.

Given a desired slag volume and composition, at the end of carbon removal, a major factor affecting slag reduction is the adequate mixing of the slag and metal. Regardless of the deoxidizer used, slag cannot be effectively reduced unless there is sufficient time and contact between slag and metal. Unless there is stirring action, the slag and metal remain quiescent at this stage of melting; chromium reduction can be markedly increased by physical disturbance rather than by chemical reaction.

Careful testing of stainless-steel baths in an 80-ton arc furnace with a 20-ft. dia. shell and a bath depth of approximately 30 in., in the centre, has revealed a difference of as much as 4.5 per cent. Cr content between the top and bottom of the bath at this stage of the heat. This enrichment of the metal layer near the slag naturally limits further reduction of chromium from the slag. The importance of this factor has been adequately demonstrated by other investigators who have found it advantageous to thoroughly mix the slag and metal after the addition of the deoxidizer by tapping into a ladle, separating the slag and returning the metal to the furnace. The advantage of this practice, however, must again be weighted by economic considerations in each shop. The furnace size appears to influence markedly the degree of chemical heterogeneity, which results from the lack of movement of the slag and metal. The larger the furnace, the greater the degree of heterogeneity.

Silicon added as a chromium-silicon ferro-alloy is most frequently used as the primary slag-reducing agent in large stainless-steel producing shops. It is known that chemically, aluminium will allow a greater reduction of chromium from the slag. In most cases, careful studies have revealed that the use of aluminium for slag reduction is not always desirable economically. Sizing, density, and melting temperatures of the reducing agent can all influence the efficiency of reduction. If a heavy-lump material is used which penetrates the slag and metal, reduction must take place solely at the slag/metal interface with the subsequent dilution of the reducing agent in iron. If the reducing agent remains suspended uniformly in the slag, some reduction can take place in the slag itself.

The effect of metal and slag temperature on chromium reduction has been reported to be inconsistent. In some cases, lower temperatures were said to be preferred and in other cases, higher temperatures, both can be correct to some extent. Chemically, the reaction between the silicon and chromium oxide should proceed further with lower temperatures. Physically, if the slag becomes too cold and viscous the reaction will be slowed because of inadequate contact or mixing of the slag and metal. Thus, a compromise must be made between the chemical and the physical factors affecting chromium reduction for optimum results.

Chromite *v.* Basic Hearths

In any steelmaking process there is a tendency for the liquid metal and slag to approach a chemical balance with the refractory container. Three types of linings are used for melting stainless steel—basic, acid, and chromite bottoms. The basic and acid bottom materials are such that they allow the metal and slag to reach a relatively low-oxygen level. When silicon is used as a reducing agent the basic-lined bottom will permit a greater chromium reduction, because of the lowered activity of silica with the use of lime and magnesia. The chromite-lined bottom is composed of iron and chromium oxides which limit the degree of deoxidation of slag and metal that can be maintained. As a result, the reduction of chromium from slags with the chromite is much lower than with the basic bottom. This fact affects the economics of the production of most types of stainless steels to such an extent that the use of the chromite-lined bottom is quite limited in the United States.

Summarizing, it is stated that for optimum recovery of chromium-units the following factors are considered to be important:—(1)—Attainment of the lowest slag volume and chromium content, consistent with an economic scrap charge and carbon oxidation practice; (2)—use of a basic bottom with a lime:silica ratio in the slag of approximately 1:5; (3)—intimate mixing of slag and metal; (4)—lowest temperatures of slag and metal, consistent with slag fluidity and slag-metal mixing, and (5)—use of a strong deoxidizer with a minimum dilution in iron.

Personal

Mr. H. McCALL has retired from the board of Charles Churchill and Company, Limited.

Mr. A. S. BEECH, chairman of Foundry Equipment, Limited, last week left by the Queen Elizabeth for New York.

Mr. W. A. T. KENNEDY has been appointed manager of the tractor sales and service department of Thomas W. Ward, Limited, Albion Works, Sheffield.

Mr. J. C. DORSIE, director of Cameron & Roberton, Limited, Kirkintilloch, is to retire on September 13, the 58th anniversary of his first day with the company.

Mr. J. W. LAMBERT who was recently awarded the insignia award in technology of the City and Guilds Institute, has been appointed works manager of Union Carbide, Limited.

Remington Rand, Limited, announce the creation of a new position of product manager. It is to be filled by Mr. J. O. V. CHRISTIAN, at present national sales manager, photo records division.

Mr. E. WILLIAMSON has been presented with a gold watch and a cheque by the directors, and other gifts from the staff and workpeople, of the Hunslet Engine Company, Limited, Leeds, on his retirement after 52 years of service.

Mr. DAVID VEITCH, who joined the firm of Smith & Wellstood, Limited, Bonnybridge, in 1936, recently retired from his position of foreman engineer. He received presentations from the directors, supervisory staff club, and other departments.

Mr. E. J. HUNTER, chairman of Swan Hunter & Wigham Richardson, Limited, has been appointed chairman of M. W. Swinburne & Sons, Limited, in succession to the late Mr. J. W. ELLIOTT. Mr. Hunter has also been appointed a director of the Glasgow Iron and Steel Company, Limited.

Mr. H. J. NIXON, works director of Alvis, Limited, recently, presented a cheque from the firm and a clock from his colleagues to Mr. J. T. GRIFFITHS on his retirement at the age of 70. In making the presentation, Mr. Nixon said that Mr. Griffiths had been with the company for 35 years, joining in 1920; during the whole of that time he had never been late and never voluntarily absent—a fine example to both management and his fellow workers.

Guy Motors, Limited, Wolverhampton, announce a number of appointments to their works staff, under the present works manager, Mr. C. W. McDONALD, who will in future be in charge of all production departments, material and production control and works engineers, including factory maintenance. Mr. H. G. HARWOOD is appointed deputy works manager and electrical engineer; Mr. R. E. SOANES, assistant works manager (production control); Mr. J. AUDEN, assistant works manager (engineering); Mr. J. H. H. COLLINGS, chief production engineer; Mr. J. YOUNG, programme controller, and Mr. F. MANSELL, production liaison officer.

Mr. M. G. BURROWS, mechanical engineer of the Southern Region of British Railways, has been appointed chief mechanical and electrical engineer (designate) of the North-Eastern Region. The appointment follows a decision to terminate the bi-regional organization with the Eastern Region, whereby there was one chief mechanical and electrical engineer's department and a single carriage and wagon engineer's department each covering both regions. In future there will be a separate organization in the North-Eastern Region under a chief mechanical and electrical engineer. As the revised organization develops, Mr. Burrows will assume responsibility for all mechanical, electrical, and carriage and wagon work in the North-Eastern Region.

Obituary

Mr. JOHN CRAWFORD, a director of the Holm Foundry Company, Limited, Kilmarnock (Ayrshire), died on July 30. He was 68.

The death is announced of Mr. LESLIE WILD, who, with his brother, started the firm of W. J. Wild, Limited, manufacturers of steel and metal pressings, etc., of Birmingham, 35 years ago.

The death has occurred of Mr. HECTOR MILLER, who was formerly chief of the test department of Drysdale & Company, Limited, manufacturers of centrifugal pumps and steam engines, of Glasgow. Mr. Miller retired five years ago having served the company for 50 years.

Mr. J. W. BERRY, who was recently appointed deputy managing director of Birmid Industries, Limited, and joint managing director of Birmingham Aluminium Casting (1903) Company, Limited, has died at the age of 67. Mr. Berry served an apprenticeship with Chance Bros., Limited, and joined the Birmingham Aluminium Casting Company in 1942, as works director; he was appointed joint managing director in 1948. He was associated with the West Bromwich, Smethwick and Oldbury joint committee for the recruitment and training of youth in engineering and became its chairman in 1951. He was also a past-president of the Birmingham section of the Institute of Production Engineers.

House Organs

Albion Works Bulletin, Vol. 11, No. 2; issued by John Harper & Company, Limited, Albion Works, Willenhall.

This issue contains an interesting report from Mr. Wilfred Harper on his visit to South Africa. His remarks as to the natives being brand conscious is very apposite, and it would not be surprising to learn that the exchange value was, say one Beatrice stove equals ten nigger pots or ¼ of a standard bicycle, or, say, 30 approved pen-knives. Such is the effect of brand consciousness amongst the natives. The chairman's warnings as to future trading conditions are of real importance.

Wild-Barfield Heat-treatment Journal, Vol. VI, No. 43; issued by Wild-Barfield Electric Furnaces, Limited, Otterspool Way, Watford By-pass, Watford.

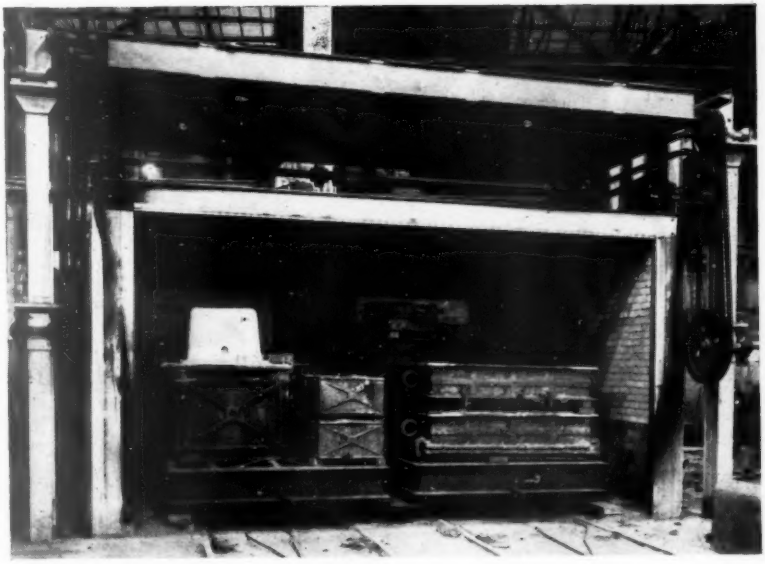
Now that Wild-Barfield have acquired a manufacturing licence from the National Research Corporation of America, it is appropriate that the opening article of this issue should cover vacuum melting. This process has long left the laboratory stage and there is an illustration of a 26-cwt. capacity vacuum induction furnace for handling steel. Discussion of heat-treatment problems takes up most of the balance of the issue.

Demag News, No. 144; issued by Demag A.G. Duisburg.

It is usual to associate this company with heavy steelworks' plant and civil engineering constructions. However, this issue has an article covering modest electric-melting and processing furnaces, such as are used by the foundry industry. It is interesting to learn that some 50 years ago this firm made the first Hércult-type furnace to melt steel in Germany.

MATHISON
MOULD DRYING STOVES
High Speed Recirculating Type

Maximum Throughput
Automatic Pyrometric Control
FUELS: **Temperature Uniformity ± 5° C.**
Oil, Coke, **Humid Atmosphere in Recirculation**
Clean Gas. **Increased Production**
FIRING CYCLE: **Savings in Fuel**
2 hrs. raising temperature **Operating Costs Reduced**
to 300° C.; 3 hours soaking. **No Burnt Surfaces**



Headroom reduced by efficient, easy operating, "Up-and-Over" door.

Clean gas fired stove installed at the up-to-date Steel Foundry of Messrs W. Shaw & Co. Ltd., Wellington Steel Foundry, Middlesbrough.

Write also for particulars of our Skin Driers

JOHN MATHISON LIMITED (Engineers)
HUTTON HALL, GUISBOROUGH, YORKSHIRE

Phone: Guisborough 59 Grams: Mathison, Guisborough

Imports and Exports of Iron and Steel in June

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in June. Totals for the first six months of this year and last are also included.

Total Exports of Iron and Steel

Destination.	Month ended June 30.	Six months ended June 30.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Channel Islands	181	2,661	1,888
Cyprus	1,030	3,560	5,847
Sierra Leone	1,890	3,478	6,989
Ghana	3,415	13,757	12,052
Nigeria	5,527	30,459	29,353
Union of South Africa	9,914	37,928	56,437
Rhodesia and Nyasaland	6,590	44,254	35,360
Tanganyika	1,547	9,818	11,452
Kenya	3,713	26,830	26,808
Uganda	204	3,014	2,053
Mauritius	309	1,550	1,874
Aden	244	2,908	2,608
Bahrein, Qatar, and Trucial States	1,030	4,936	7,313
Kuwait	2,679	2,649	15,998
India	13,537	153,607	144,977
Pakistan	7,576	26,004	31,884
Singapore	2,534	15,771	20,785
Malaya	2,176	19,286	19,279
Ceylon	2,326	17,266	15,013
British North Borneo	334	3,464	2,120
Hongkong	6,343	32,062	49,643
Australia	13,363	112,605	102,916
New Zealand	19,510	99,856	99,724
Canada	25,136	148,526	144,261
Jamaica	1,746	12,792	12,396
Trinidad	4,212	20,389	23,828
British Guiana	389	2,568	3,510
Other Commonwealth countries	2,263	13,578	16,418
Eire	2,862	36,281	22,111
Finland	6,854	26,524	47,524
Sweden	11,063	63,116	59,817
Norway	10,497	43,466	61,003
Denmark	7,724	36,289	58,271
Western Germany	341	5,996	6,454
Netherlands	9,770	43,750	58,431
Belgium	3,804	20,515	21,631
France	1,786	4,297	9,980
Switzerland	2,016	7,264	10,239
Portugal	1,883	4,851	10,904
Spain	4,638	17,569	22,917
Italy	4,870	10,297	25,875
Austria	302	2,543	2,121
Yugoslavia	752	4,539	4,857
Greece	1,282	2,868	5,395
Turkey	64	2,857	3,042
Netherlands Antilles	480	5,305	2,166
Portuguese East Africa	552	1,523	2,559
Egypt	—	26,707	469
Sudan	2,283	8,081	10,191
Lebanon	1,760	4,657	3,169
Israel	801	5,250	2,600
Saudi Arabia	312	7,116	2,735
Iraq	3,589	18,082	20,298
Iran	6,993	40,380	34,990
Burma	2,848	3,465	11,284
Thailand	201	3,729	4,078
Indonesia	1,142	5,869	4,251
Philippine Republic	405	3,728	1,125
USA	4,638	23,853	26,218
Cuba	1,716	4,642	5,064
Colombia	823	1,443	2,862
Venezuela	9,938	36,015	55,537
Ecuador	204	1,546	1,453
Peru	748	8,983	6,272
Uruguay	750	2,889	4,200
Argentina	6,083	26,279	42,104
Other foreign countries	11,903	21,139	72,213
TOTAL	268,395	1,459,279	1,649,196

Total Imports of Iron and Steel

From	Month ended June 30.	Six months ended June 30.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Rhodesia and Nyasaland	584	1,503	2,586
Canada	4,561	28,892	27,595
Other Commonwealth countries and Eire	2,231	3,427	12,977
Soviet Union	31,506	159,161	139,780
Sweden	2,166	24,049	16,626
Norway	6,788	50,123	61,651
Western Germany	7,104	119,935	54,722
Netherlands	3,166	57,965	24,943
Belgium	19,066	213,854	91,587
Luxembourg	1,751	36,612	16,647
France	6,369	153,840	35,905
Italy	423	5,981	1,452
Austria	7,135	81,790	41,973
Japan	1,012	9,552	7,600
USA	26,268	313,385	104,665
Other foreign countries	865	43,440	21,154
TOTAL	120,995	1,303,509	661,863
Iron and steel scrap and waste, fit only for the recovery of metal	66,582	500,093	393,320

Exports of Iron and Steel, by Products

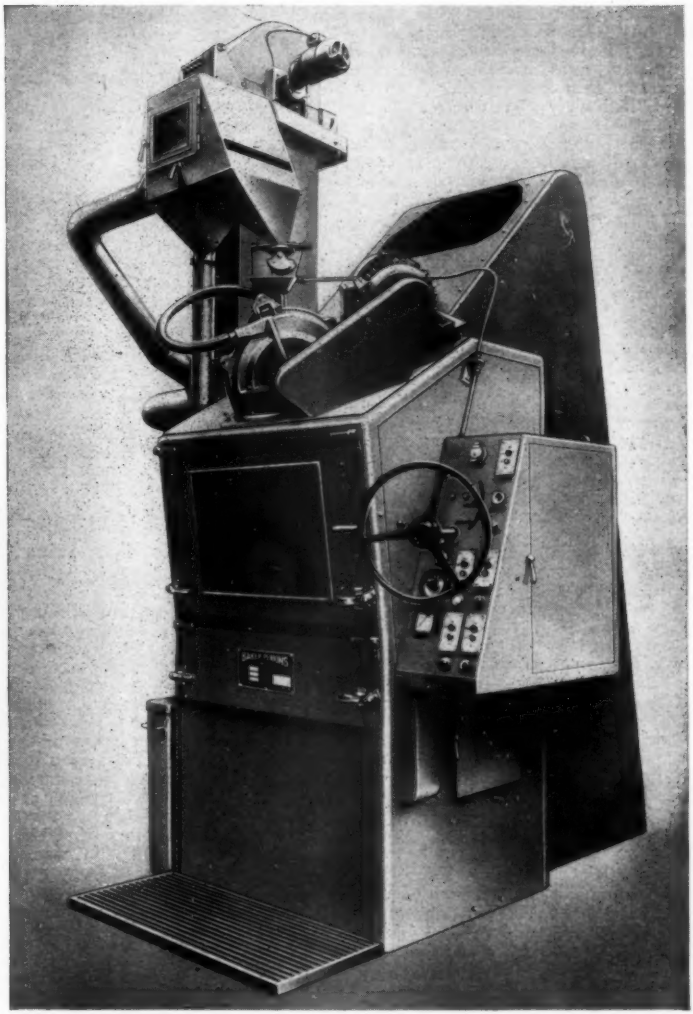
Product.	Month ended June 30.	Six months ended June 30.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Pig-iron	5,775	60,773	71,817
Ferro-columbium (niobium)	4	90	70
Ferro-tungsten	33	565	355
Other ferro-alloys	199	2,140	1,641
Ingots, blooms, billets, slabs, sheets, and tinplate bars	117	1,077	690
Iron bars, rods, angles, shapes, and sections	155	1,217	1,061
Steel bars, rods, angles, sections, and shapes	47,250	234,720	271,238
Iron plates and sheets	11	93	91
Universal plates	694	2,648	3,916
Steel plates, ¼ in. and under ⅜ in.	1,102	5,437	5,691
Do., ⅜ in. and over	14,879	121,893	102,878
Blacksheets and blackplate	26,143	118,994	172,509
Hoop and strip	7,627	47,024	49,525
Tinplate	32,780	151,915	212,374
Decorated tinplate	437	3,769	2,494
Galvanized sheets	18,545	74,746	107,428
Other (including tinned sheets, terneplate, and ternesheets)	1,277	7,576	10,841
Railway and tramway construction material	25,297	155,368	139,812
Wire rods	8,346	19,007	30,721
Wire	8,214	40,566	55,684
Tubes, pipes, and fittings	68,684	395,574	402,056
Iron castings	87	1,075	882
Steel castings	165	934	1,377
Forgings	574	2,078	4,045
TOTAL	268,395	1,459,279	1,649,196

THE INSTITUTE OF FUEL announces that the second conference on "Pulverized Fuel" will be held at the Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1, from November 27 to 28.

CONTINUOUS ANNEALING PLANT installed at the Velindre Works of the Steel Company of Wales, Limited, was manufactured and installed by the Incandescent Heat group, as main contractors, and designed in collaboration with their associates, the Drever Company of Pennsylvania, USA, whilst the strip-handling equipment was supplied by the Davy and United Engineering Company, Limited, of Sheffield.

BAKER PERKINS Shot Blast Equipment

Rotating Barrel Shot-Blast Machine



BAKER PERKINS LTD
Engineers
WESTWOOD WORKS — PETERBOROUGH

Raw Material Markets

Iron and Steel

With many foundries still closed for holidays, there has been little reaction to the price increases on pig-iron. It is certain that the price of castings will rise as, apart from the advanced prices of pig-iron, there have been recent increases on all other raw materials, including scrap, coke, limestone, etc., and the extra 10 per cent. on freight charges which came into effect on August 1. Forced by competition for both home and export business the foundries have absorbed some of the previous increases. What effect the increased prices will have on future business remains to be seen, but many establishments, particularly the light foundries supplying castings for domestic equipment, etc., have been short of work for some time and higher prices will not improve their prospects.

It is also unlikely that foundries will want to carry stocks of pig-iron and other materials so long as the supply position remains easy, and they will be content to order only essential tonnages.

With many consumers of castings also on holiday, demand is also practically at a standstill. Only a few of the engineering foundries consider it advisable to remain open for the receipt of pig-iron, particularly the preferred low-phosphorus grade. As supplies are none too plentiful they are anxious to receive the tonnages available.

Production of pig-iron continues at recent levels, the steelworks readily accepting the major supplies in basic pig-iron. Distribution of the foundry grades is affected by holidays and the furnaces find it necessary to place additional tonnages into stock, particularly in the high-phosphorus grades. Larger quantities are, however, being shipped overseas, and this is relieving the pressure on stocks. Apart from the low-phosphorus irons, which are generally fully taken up, the supply of other foundry pig-irons, hematite, and refined irons is easy.

Holidays continue to affect production at the re-rollers and outputs of their products are consequently reduced. They are in a fairly good position so far as business is concerned as steady demands continue for small bars, light sections, and strip. For some sizes, such as reinforcing bars, there is a heavy demand. Outputs of steel semis from home steelworks are reduced, but the re-rollers have fairly good stocks of most sizes and grades. Adequate supplies continue to be received from home steelworks, together with some consignments of imported material, although the latter are much reduced.

Non-ferrous Metals

Non-ferrous metal markets on both sides of the Atlantic remain under the influence of the holiday season and price changes, though small, have been generally towards lower levels. Early last week two leading US primary producers cut their price ¼ cent to 28½ cents a pound. Later in the week Anaconda came into line, so that copper producers in the US are now quoting a flat rate of 28½ cents a pound. At the lower price level, producers reported better tonnage orders for this month than they received in July. Custom smelters are still only ¼ cent below the producers' quotation. This has been interpreted as reflecting the lack of any business rather than as a determination to hold their price level. In any event, Custom smelters are not so much interested in the actual price level as being able to acquire their raw materials at a reasonable profit margin. Copper for export is available at about 27 cents a pound and scrap is easier at 22½ cents a pound. The reduction in price brought about a further easing of prices in London and on Friday last week cash copper went down to £209 15s., thereby establishing a new low since dealings were recommenced on the LME nearly four years ago. On Monday the Rhodesian Selection Trust basic price for copper to UK consumers was cut by £10 a ton to £210. Demand is fair, but with stocks well over 12,000 tons and at their highest post-war level, the contango continues to widen.

Tin has been a weak market and prices are now only £10 above the level—£730 a ton—at which the Buffer Stock manager may buy the metal. Stocks in the UK continue to rise and the backwardation has at last disappeared. At the end of the International Tin Council's meeting in London the *communiqué* gave the news that as at March 31 last the Buffer Stock had no stocks of metal. The tin market in New York continues quiet and the price is around 94½ cents a pound.

Zinc is quietly steady in London and "spotty" in New York, where the price is holding at 14 cents a pound. The market here is firmer, but somewhat uncertain on mixed hopes and fears concerning the US plan to introduce a sliding scale of duties on imports of lead and zinc. The plan is now awaiting action by the House Ways and Means Committee and there has been a certain amount of precautionary buying in anticipation of higher import duties. However, US stocks of refined metal at the end of July amounted to 146,153 tons—the highest level for four years.

Lead is also quietly steady here, but fairly good in New York with the price firm at 14 cents a pound. The market is favourably affected—so far—by the US plan to introduce a sliding scale of import duties, but consumer buying has also improved.

European Foundry Apprentices' Competition

A firm decision has now been taken in favour of UK participation in the European Foundry Apprentices' Competition to be held this year in Stuttgart, Germany, from November 25 to 30. Accordingly, applications and nominations of prospective UK competitors are invited *before August 31*; these should be sent to local secretaries of the Institute of British Foundrymen or the head office at Manchester, as the IBF has agreed to undertake the necessary preliminary screening of entries, before passing them on to Mr. J. Collett, training officer, Council of Ironfoundry Associations, 14, Pall Mall, London, S.W.1, who is handling the UK arrangements. (Details of the competition were printed in this JOURNAL, July 25, page 109; any further queries should be addressed to Mr. Collett.)

THE UNITED STATES STEEL CORPORATION has declared a quarterly dividend of 75 cents per share, the same as for the two previous periods, but comparing with 65 cents for the corresponding quarter a year ago. The 1956 total was $2.70 per share.

THE NEW MECHANIZED FOUNDRY of Sterling Metals, Limited, the heating and ventilating systems of which were described in last week's JOURNAL (page 169), is to be used for the production of cast-iron cylinder blocks, and not for small non-ferrous castings as stated. Apologies are offered for this and the statement it contained that this was the first completely automatic foundry in the country.

In this type of sand mixer 'FULBOND' ensures an even mix with higher permeability and strength.

For service and information write to :

THE FULLERS' EARTH UNION LTD.

Patteson Court, Nutfield Road, Redhill, Surrey

Telephone: REDHILL 3521

CMF. 20

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

August 14, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

Scotch Iron.—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S. 1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £53 5s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 5d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 5d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3¾d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £87 19s. 3d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £33 1s. 6d.; tested, 0.08 to 0.33 per cent. C, £34 1s. 6d.; hard (0.41 to 0.60 per cent. C), £35 3s. 0d.; silico-manganese, £44 2s. 6d.; free-cutting, £37 5s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £41 7s. 0d.; silico-manganese, £44 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.33 per cent. C, £38 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 18s. 6d.; acid, up to 0.25 per cent. C, £43 10s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £42 12s. 0d.; boiler plates (N.-E. Coast), £45 2s. 0d.; floor plates (N.-E. Coast), £44 1s. 0d.; angles, N.-E. Coast, £40 6s. 6d.; joists, N.-E. Coast, £40 2s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats, 5 in. wide and under, untested soft basic, 50 tons and over, £40 8s. 0d. (under 10 tons to 4 tons, £41 5s. 6d.; under 4 tons to 2 tons, £41 10s. 6d.); hoop and strip, coils, £40 10s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £45 16s. 0d.; black sheets (hand mill), 24 g., £59 4s. 6d.; galvanized corrugated sheets, 24 g., £68 17s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £69 9s. 6d., nickel-chrome, £100 12s. 6d.; nickel-chrome-molybdenum, £112 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £208 0s. 0d. to £208 5s. 0d.; three months, £210 0s. 0d. to £210 5s. 0d.; settlement, £208 5s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 0¾d. per lb.; rods, 228s. 6d. per cwt. basis; 20 s.w.g., 271s. 9d. per cwt.

Tin.—Cash, £737 10s. 0d. to £738 0s. 0d.; three months, £739 10s. 0d. to £740 0s. 0d.; settlement, £738 0s. 0d.

Lead (Refined Pig).—First half August, £91 5s. 0d. to £91 10s. 0d.; first half November, £91 7s. 6d. to £91 10s. 0d.

Zinc.—First half August, £73 12s. 6d. to £73 15s. 0d.; first half November, £73 0s. 0d. to £73 5s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £107 10s. 0d.; rolled zinc (boiler plates), all English destinations, £105 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £90.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 8½d. per lb.; rods, drawn, 2s. 11d.; sheets to 10 w.g., 180s. 3d. per cwt.; wire, 2s. 5½d.; rolled metal, 180s. 3d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £146; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £198; HTB2 (38 tons), £210; HTB3 (48 tons), — .

Gunmetal.—BS1400, LG2 (85/5/5/5), £184; LG3 (86/7/5/2), £196; G1 (88/10/2/½), £257; (88/10/2/1), £242.

Phosphor Bronze.—BS1400, PB1 (AID released), £271 per ton.

Phosphor Bronze Strip, etc.—Strip, 259s. 6d. per cwt.; sheets to 10 w.g., — per cwt.; wire, 3s. 9½d. per lb.; rods, 3s. 1d.; tubes, 3s. 1d.; chill cast bars: solids 3s. 0½d., cored 3s. 1½d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 7½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 0½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 11½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £87 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, — ; AB2, £255.

* Average 68-70 per cent.